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The Outlook

Carriers in the Pacific

THE war in the Pacific depends on sea power, and sea power includes a due proportion of air power. That ocean is an ideal part of the world for the operations of aircraft carriers, and Japan opened her attack on the United States by a clever use of her carriers, while shortly afterwards she used shore-based torpedo-bombers to sink the two British capital ships which should have been the core of the strength of Singapore. At present it must be admitted that the Japanese hold command of the Western portion of the seas between the continents of Asia and America.

The other day Col. Knox was asked what the American Fleet was doing, and, naturally, he declined to make a definite answer, putting the questioner off by a general statement that Germany was the chief enemy and that the Battle of the Atlantic was the most crucial struggle now going on. While nobody will quarrel with that remark, everybody is still wondering what the American battle fleet is really doing. Singapore is too valuable to all the Allies for it to be abandoned without a great effort, and Australia is emphatically urging that the Pacific must not be treated as a mere sideshow. If Mr. Churchill and President Roosevelt had regarded it in that way, they would hardly have given Gen. Wavell his new and unprecedented command.

It is obvious that the best way to relieve Singapore, the Philippines, Borneo, and to recover Hong Kong would be to engage and defeat the Japanese battle fleet. It is impossible to avoid the assumption that the American fleet (probably with British support) is seeking to find and engage the Japanese. When a fleet is busy on such a task the public never hears any news from it, and questioners are apt to be put off by such generalities as Col. Knox uttered. The search must be largely, or even entirely, a matter for the aircraft off carriers. The U.S. carrier *Lexington*, which operates about 80 aircraft, must be in the Pacific, for the Japanese have made several claims to have sunk her. We do not know where her sister ship the *Saratoga* is, or the other American carriers, pictures of some of which we publish this week. The Japanese strength in carriers is also not known, but before the war they went in largely for seaplane carriers, which are of limited use. But we may be sure that all available carriers are very busy just now in the Pacific Ocean.

Malta

WHEN the history of this war comes to be written, few chapters will be more astonishing than the one which tells how Malta was gradually transformed from a precariously held defensive post into a pivot of air aggression in the Mediterranean. From the first it was recognised that it could not continue as the headquarters of the Mediterranean Fleet when Italy was our foe, for a fleet in harbour is a tempting bait for enterprising enemy raiders. The Italians learnt that lesson at Taranto, though the expensive failure of the *Luftwaffe* to sink H.M.S. *Illustrious* when she was receiving first aid in the Malta dockyard seems almost to invalidate that general maxim.

At any rate, Malta was first regarded as a sort of liability to the British Empire, certainly to be held as long as possible, but rather as a heroic patient than as a vigorous surgeon. The staff officer at Cairo who last week reviewed the work of the Middle East R.A.F.

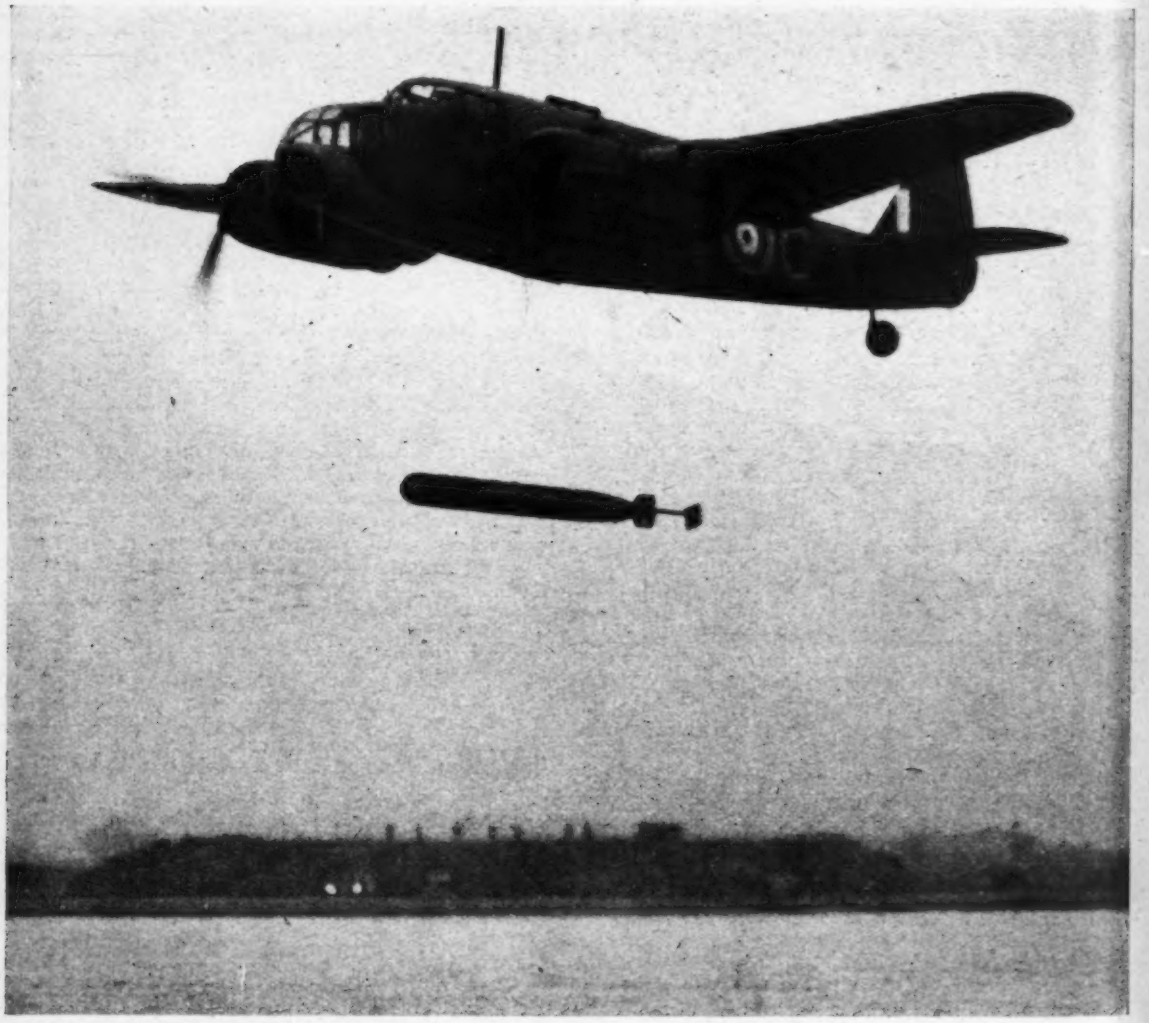
Command during the past year said of Malta that throughout the year it had been "a terror to Italian shipping, to the Italian and Sicilian ports, and to many places in North Africa, particularly Tripoli." As a result the Axis aircraft have lately been keeping up a continuous series of raids on the island in the hope of blunting its teeth. The indications are that the enemy has lost far more aircraft on the airfields of Sicily than he has been able to destroy by attacking Malta.

Doctrines have altered since the war began, and no longer do we think of air defence as a futile thing because "the bomber will always get through." We have learnt that well-organised air bases can continue to operate even when they are repeatedly raided by bombers, and that if one's air defence is good, one can proceed to air attack.

The Prime Minister's Flight

PERHAPS civil flying may claim the safe return of Mr. Churchill from America as a feather in its cap, for he used a commercial Boeing flying boat belonging to British Airways. Civil air transport has a hard task at the moment to persuade the world that the discovery of flight has been of benefit to the world, for millions of civilian sufferers have cursed the flying machine in the last two years and wished that Cayley, Stringfellow, the Wright brothers, and the rest of them had never been born. Yet, now that we are all in a horrible war and are grateful for everything which brings victory nearer, we must bless the invention which enabled our Prime Minister to come safely back from the American continent, where he has done much for the cause of victory and freedom. Future ages will count this flight as one of the greatest benefits which aircraft has conferred on mankind.

We need not now worry as to whether the Germans would have violated the rules of war if they had found the flying boat *Berwick* and shot it down. They would certainly have done so if they could, and such a disaster would have been a heavy blow to the cause of freedom. But Mr. Churchill is safe home, and we are all profoundly thankful. His conference with Mr. Roosevelt ought to hasten the day of victory.



DAVY JONES' SHOCKER: Dropping a torpedo from a Coastal Command Beaufort. Up to recently torpedoes had to be dropped from a very low altitude, otherwise they were likely either to break in half on impact or leap out of the water and change direction.

War in the Air

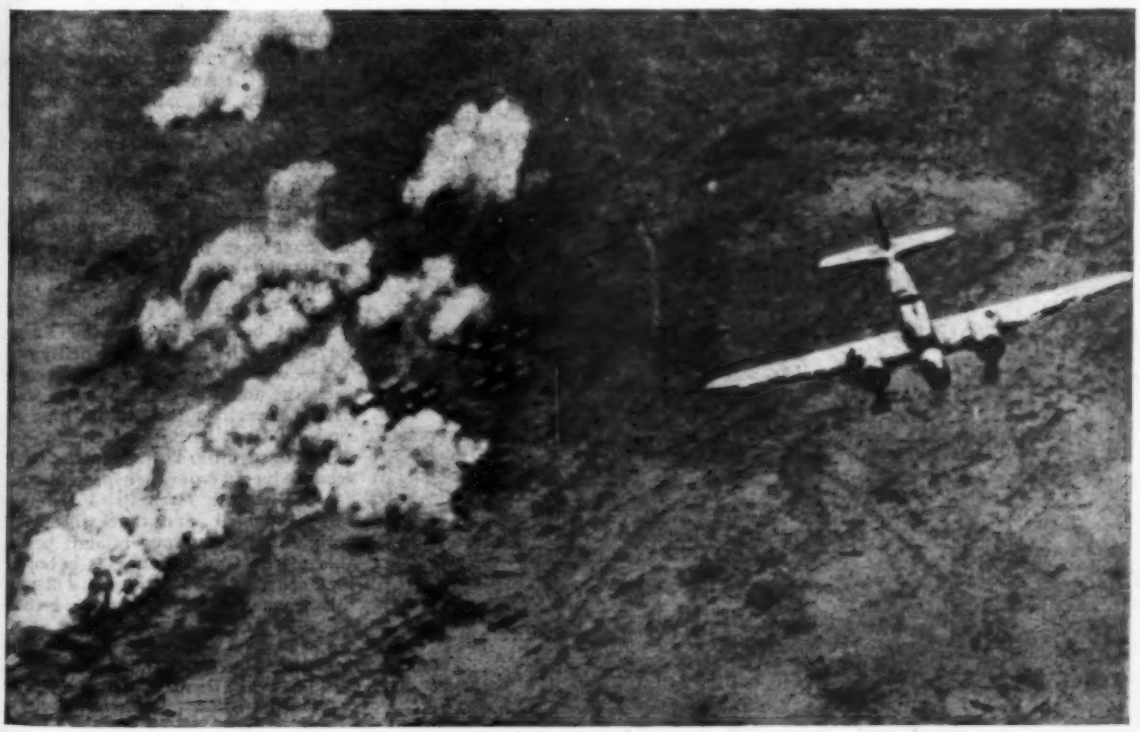
Rommel's Predicament : Wavell Gets to Work : Japanese Bombing Inaccurate : Enterprising Dutch Airmen

IMPORTANT fighting has been going on in pretty well every area of the war, but not all of it has produced news of real air significance. The Russian advance has, in all likelihood, the greatest influence on the main strategy of the war, and we may take it that such an advance could not take place without powerful help from the Red Air Fleet; but in the recent communiqués there has not been much mention of air operations.

The Mediterranean as a whole is of vast importance, and Field Marshal Smuts has prophesied that the final struggle of the war would take place in that region. In that sea the Axis Powers have been making the most determined efforts to paralyse Malta, as from that island heavy and medium bombers set out to harry the Axis in all directions. Perhaps it is wrong to describe the Axis efforts as "determined"; they have rather been numerous and almost continuous; but, judging from the results, they have not been pressed home with any great determination. If they had been, we should have heard of more enemy fighters and bombers shot down by the very good A.A. batteries on the island and by the Hurricanes. The enemy losses of late have been on a modest scale, and likewise the damage done by the enemy bombs is not reported to have been heavy. But it is certainly clear that the Axis regards Malta as a thorn in its side, whereas at the beginning of the war it was regarded by the Italians as a liability to Britain, and, in any case, a rightful appendage of the Italian peninsula. By this time the Maltese must hate the Italians (and, incidentally, the Germans) tenfold more than they hated them before; and they never had any strong affection for their neighbours.

The Desert Battle

WHEN General Auchinleck opened his attack on General Rommel, it was said that a battle of tanks in the desert resembled a naval engagement. In its later stages this battle has assumed a striking resemblance to that of Jutland, with the Germans striving to escape and the British straining every nerve to intercept them. The Germans claimed a victory at Jutland because they succeeded in achieving their object of escaping, though they could hardly claim that their High Seas Fleet ruled the North Sea as a result of the action. Rommel is in much the same position. He no longer has any hopes of holding Cyrenaica, but he does want to get his remaining tanks (probably heavy tanks) away to Tripolitania, where they would be a strong reinforcement to the Axis garrison there whenever the Empire forces and Free French decide to move up to the borders of Tunisia. Unfortunately, our aircraft do not seem able to halt these heavy tanks, though they have taken heavy toll of lighter vehicles. A certain amount of supplies, including petrol, has obviously been getting through to Rommel, despite all that our air forces could do, and doubtless the heavy tanks have first call on it. Other lighter tanks have been found abandoned in the desert in good condition, obviously because the R.A.F. has cut off their petrol supplies. Bad weather has worked



TURNING ON THE AXIS : South African Air Force Marylands bombing an Italo-German encampment at El Adem.

FREE FRENCH FIGHTERS : A Spitfire squadron of the Free French which is now operating with Fighter Command. It is stationed in Scotland.

WAR IN THE AIR

against the stronger air power and has helped the Germans and Italians to make progress towards their haven.

In the Pacific General Wavell has established his headquarters in Java. Since the sinking of H.M.S. *Prince of Wales* and *Repulse* the Dutch island has obvious advantages, and, moreover, its selection marks the fact that General Wavell's command is international and not merely a British concern. It is also a compliment to the Netherlands East Indies, whose air and naval forces have been striking at the Japanese in the most spirited fashion. Several Japanese troopships and some warships have been hit by Dutch bombs, and a single Dutch flying boat has bombed an enemy base in the southern Philippines—a gloriously audacious piece of work.

As the Japanese advance southward in Malaya, Singapore has had more air raids, and one day last week about 50 enemy bombers escorted by 20 naval fighters, flying very high, attacked the place. Our fighters intercepted the raiders and took toll of them. The art of bombing does not appear to have reached a high level of accuracy in Japan, and the experience of dropping bombs on helpless Chinese towns has not prepared their air crews for meeting British and Australian fighters, let alone the A.A. guns of Singapore.

The Americans in Luzon have had the same experience. When nine Japanese bombers flew over the fortress of Corregidor in Manila Bay two of them were shot down by A.A. fire and others damaged, while the fortifications and troops suffered little. This was daylight bombing, to which it seems that the Japanese airmen are most partial. They do not seem to care for bombing by night, and it is true that if they are bad shots by day they are likely to be worse by night.

The Middle East Reorganised

ONE cannot separate the air side of this war from the other sides. What affects one must affect the others. Therefore, it is interesting to hear that the land forces in Iraq and Iran are to be transferred from the charge of the C.-in-C., India, to the C.-in-C., Middle East, that is to say, General Auchinleck. No mention is made of the air forces in those countries, but at an early stage of the war the squadrons in Iraq were placed under the A.O.C.-in-C. at Cairo, who naturally withdrew most of them for service elsewhere. Consequently, when the Iraq revolt broke out, the air and land reinforcements had to come from India. It may be taken for granted that now Sir Arthur Tedder's responsibilities coincide geographically with those of General Auchinleck. It would be madness to make any other arrangement, and in the present war the British War Council has not been prone to that sort of madness. Unity of command is one of our watchwords, and, if in the Middle East there are two Commanders-in-Chief, our fortunes have not hitherto suffered thereby. The Army and the Air Force have worked together in an absolutely model manner. In acknowledging this we do not deprecate the insistence of the Australian General, Sir Iver Mackay, that in such operations it is best of all for the Army commander to have complete control over everything, but the next best thing is to have two commanders who will work in absolute unison.

Looking ahead, we also welcome the pact between Greece and Yugo-Slavia. In the present war neither of these countries had sufficient air strength and we British were not strong enough in the Middle East to send sufficient help. For the future, that is to say after both countries have been delivered from their present conquerors, the air strength of the two will be pooled, and that will make both infinitely stronger and better able to resist aggression. It is hoped that other Balkan countries will join this league in due course, and then

A CHEERING SIGHT : Stukas left behind by the Germans in their retreat across Cyrenaica. In the foreground is an auxiliary petrol tank which can be carried under the wing and jettisoned when empty.

ENEMY AIR LOSSES TO JAN 17th.

	Over G.B.	Over Continent	Middle East	Far East
Jan. 11	1	0	3	9
" 12	0	0	0	10
" 13	0	0	1	1
" 14	2	0	3	3
" 15	1	0	2	2
" 16	1	0	2	4
" 17	0	0	1	1
	5	0	12	30

Totals : North, 5,165 ; Middle East, over 3,437 ; Far East, 30. Some in the Far East were shot down by the Dutch.

BRITISH AIR LOSSES TO JAN. 17th.

	Over G.B. A'crft.	Over Continent B'brs.	Over Continent Ftrs.	Middle East A'crft.	Far East A'crft.
Jan. 11	0	0	0	4 (1 p'lt safe)	0
" 12	0	0	0	4	2
" 13	0	0	0	4	0
" 14	0	5	0	9 (5 p'lts safe	0
" 15	0	6	0	0	1
" 16	0	0	0	0	0
" 17	0	3	0	0	0
	0	14	0	21	3

Totals : North, 3,169 ; Middle East, 897. Far East, 3.

that troubled part of Europe should no longer be a temptation to ambitious dictators.

The fall of Halfaya will be a great relief to General Ritchie. It opens the coast road to supplies for his advanced troops, and it sets free the infantry, artillery, aircraft, and naval vessels which had been attacking the stronghold. Cyrenaica is now wholly in our hands, but there remains the important task of preventing General Rommel from getting his heavy tanks away into Tripolitania. It may be that this clearing of the coast road will enable the guns to be brought up which will be best able to deal with those heavy tanks, but all the time it is necessary to stop as many supply columns as possible from reaching the retreating German and Italian forces. That is a task for our aircraft, and we cannot have too many of them on the job. Certainly some stores, and especially petrol, have been reaching Rommel, despite all that the indefatigable R.A.F. has been able to do. The bombers which were used against Halfaya will now be available to attack the supply lines.

Rommel has recently been supported by more aircraft, but it is for our fighters to deal with them, and reports indicate that they have been equal to the task. If we could settle finally with Rommel, we might let Tripoli wait for a time while we sent air reinforcements to Malaya.

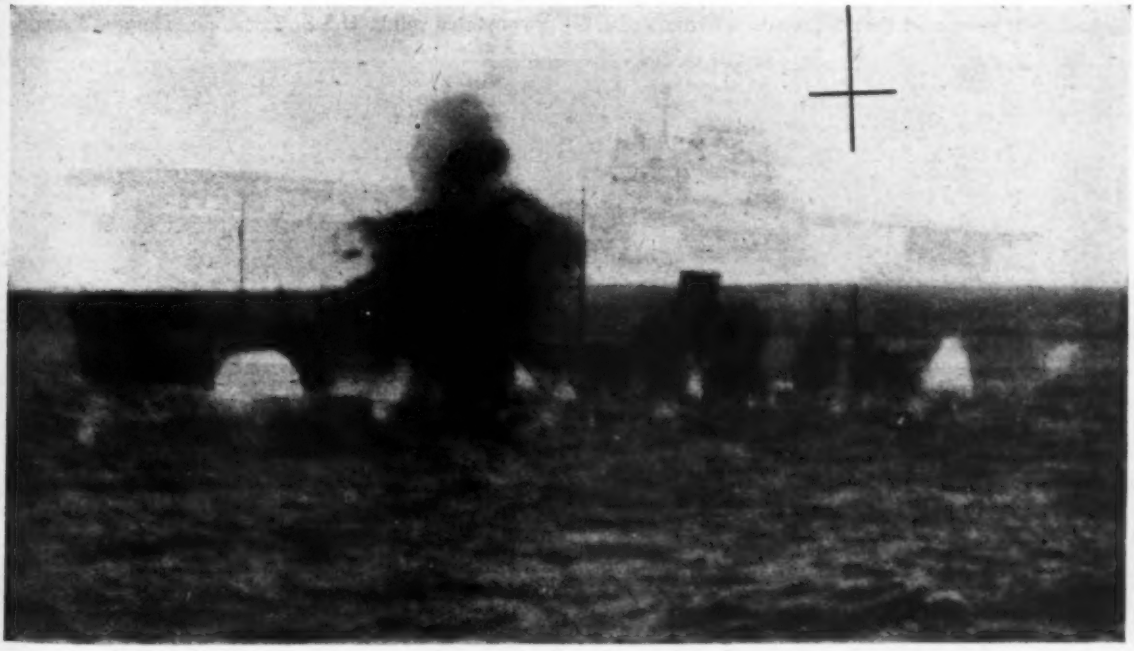
The Pacific Zone

THERE are signs that our defences in Malaya have been growing stronger both in ground troops and in aircraft. Certainly it is rather more than a nuisance that the Japanese have succeeded in setting our oil stores at Singapore on fire, but there is no indication that our aircraft have been kept aground by that contretemps. The Japanese air raids have not been very damaging, apart from that one success, while our own air attacks on them have been more frequent and more deadly in the last few days. The British and Indian troops who have fought such gallant delaying actions in northern Malaya have now fallen back on the main body of Australians, and these fresh troops, who must have been waiting with the utmost impatience for the chance to get at the enemy, have given him a taste of their quality. Our fighters and bombers have been attacking the boats bringing up Japanese landing parties, and it is to be hoped that the enemy will not be able to repeat his manœuvre of turning our flanks by landing more troops in the rear of our firing lines.

At the same time the American troops in Luzon have been holding their own in their shortened lines with the utmost gallantry, and recently with better success. They have endured dive-bombing, and do not seem to have any help from U.S. aircraft.

The Japanese army is large, but it is not unlimited, and cannot be strong at all points. While the Japanese have been gaining temporary successes in the Pacific, they have suffered another heavy defeat at the hands of the indomitable Chinese at Changsha.

The Russians continue to drive the Germans back, while in the north-western part of Europe the R.A.F. sends out its bombers to play havoc with German ports and production whenever the weather permits. It has not been favourable of late, but no opportunity is missed of dropping heavy bombs on Emden, Hamburg, and the Ruhr.



TANKER BUSTER : An enemy oil tanker receiving the attentions of a Blenheim bomber of Mediterranean Command off the coast of Tunisia. One bomb has just exploded amidships and the ship is being machine-gunned.

AMERICA'S NEW CARRIERS

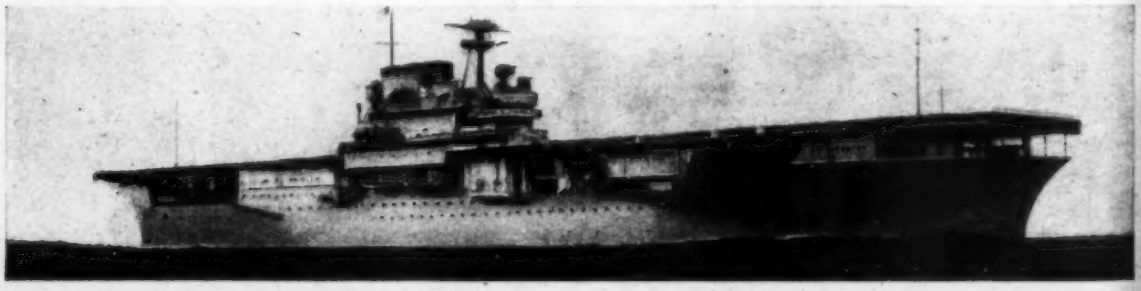
Photographs of the Latest Additions to the U.S. Navy's Air Strength: Torpedo-bomber Wing-folding Problems

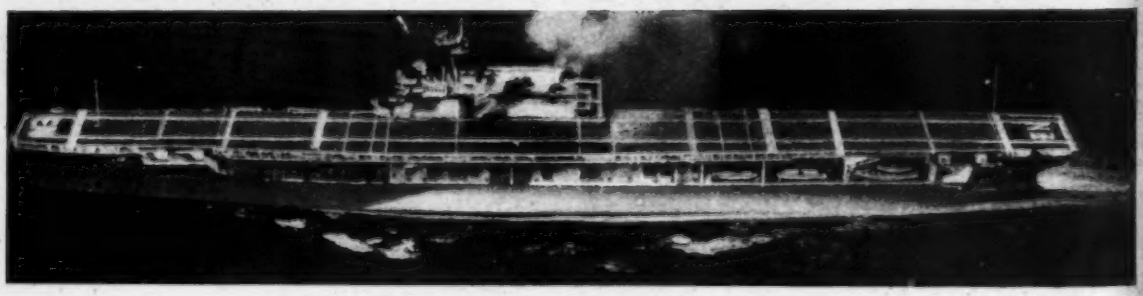
IN our issues of January 9th and December 11th, 1941, we dealt with the aircraft carriers of the world, and those likely to be used in the Pacific Ocean, respectively. At the time these articles were published there were no photographs available of any of the American ships built after U.S.S. *Ranger*, which, incidentally, was the first American carrier to be designed as such; all the previous ships were conversions from liners or cruisers. By the courtesy of the American journal, *Flying and Popular Aviation*, it is now possible to publish photographs of the latest aircraft carriers in service with the U.S. Navy.

The two sister ships U.S.S. *Yorktown* and *Enterprise*—which were built next in order to the well-known *Lexington*, *Saratoga* and *Ranger*—were completed in 1938, but very little information has been published hitherto. U.S.S. *Hornet* is a later ship than the *Yorktown* and *Enterprise*, but is very similar in general layout and tonnage. The *Wasp*, on the other hand, is a much smaller carrier, having a standard displacement of only 14,700 tons as against the 20,000 tons of the other three ships. It was authorised in 1934, and first commissioned in April, 1940.

According to our American contemporary, the U.S. Navy is to have a further eighteen aircraft carriers as part of the naval expansion programme. Seven of these are already in commission, and two more are now on the stocks. It is presumed that these are not true aircraft carriers, which are armoured ships capable of operating in a fleet action, but are converted merchantmen for use on convoy work. The Royal Navy has a number of ships of this type—one of them, H.M.S. *Audacious*, was lost during the recent five-day attack on an Atlantic convoy. The names of the seven ships already in service are not given, but those which are yet to be built or converted will be U.S.S. *Essex*, *Bon Homme Richard*,

The Douglas Devastator, which is the standard torpedo bomber of the U.S. Navy. It is a three-seater with fixed and free guns. In the retracted position about half of the wheels project into the air stream. No performance figures may be given.



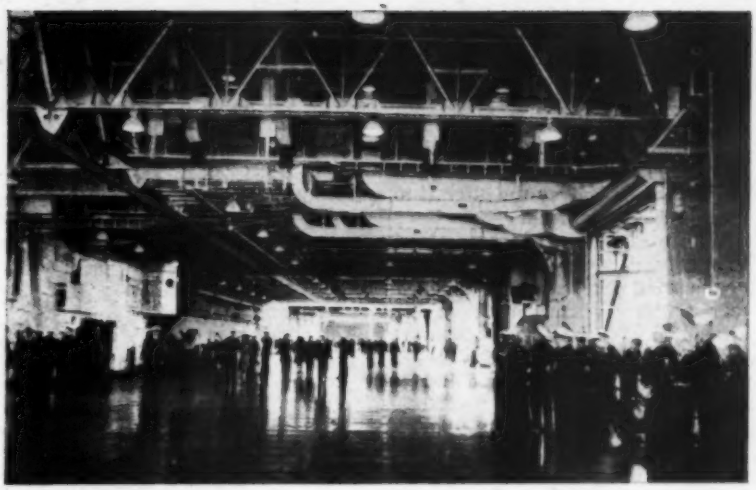


U.S.S. *Yorktown* (above) and *Enterprise*, which are sister ships of 19,900 tons displacement. Each carries about 76 aircraft, made up of four operational squadrons, of 18 machines each, and four non-operational "utility" types. Designed speed was 34 knots, and their heavy A.A. armament consists of eight 5in. high-angle guns. There is, of course, a large number of smaller pieces.

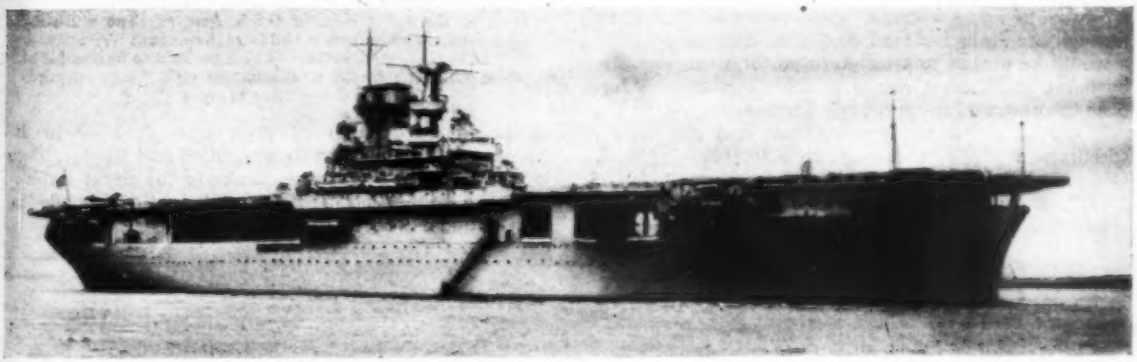
Intrepid, Kearsarge, Franklin, Hancock, Randolph, Cabot, Bunker Hill, Oriskany and *Teconderoga*. On the American carriers the commanding officer, executive officer and navigating officer are all naval airmen capable of understanding the flying problems of what is termed the air department of the ship.

This air department is responsible for all administration and control of the flying programme. The squadrons embarked remain as such, but are also absorbed into the greater unit of the air department. Maintenance of aircraft, storage and upkeep, personnel and living accommodation all come under the same command.

The U.S. Navy has always been a great advocate of dive-bombing. In fact, it may be said that all the early development work was theirs.



An interior view showing the extent of the hangar deck of U.S.S. *Hornet*, which went into commission as recently as October 20th, 1941. Its layout and tonnage are similar to those of the *Yorktown* and *Enterprise*.



U.S.S. *Wasp*, a vessel which has cost some $4,000,000. Tonnage, 14,700; length on waterline, 688ft.; beam, 80ft.; draft, 20ft. Built to the accepted modern pattern with an "island" bridge and control tower on the starboard side slightly forward of the beam.

Each perforation in the deck surface houses a sunken hook for tying down aircraft on the flight deck.

They have not, however, lost sight of the value of the torpedo-bomber type. As in our Fleet Air Arm, the type of aircraft used is capable of both jobs; but, whereas we favour the biplane for this work, the U.S. Navy have a low-wing cantilever monoplane, the Douglas Devastator, which is built to modern standards of performance. This, however, has only been found possible since new designs of torpedoes have come into use which enable drops to be made at a much greater height and speed than was previously possible. With the older pattern torpedo—which was virtually the same as that used by surface ships—it was necessary to come down to within 15ft. of the surface and slow down while the drop was made. The modern torpedo is capable of withstanding

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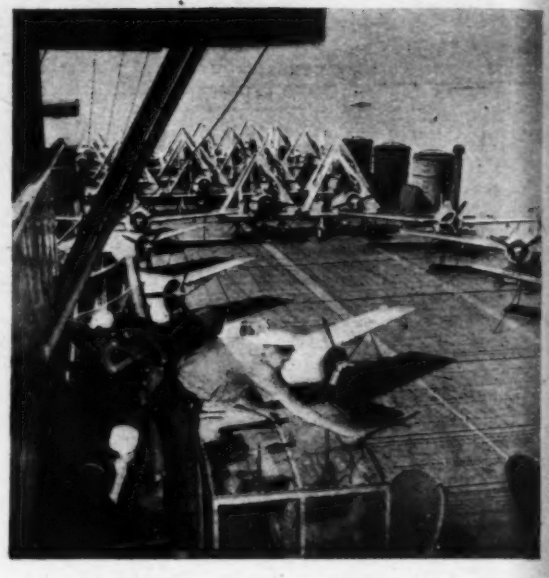
a much more dashing attack from 100ft. or more.

One of the greatest problems in the design of carrier-based aircraft is the necessity for wing-folding in order that they may be accommodated on the limited area of the lifts which convey the aircraft to and from the flight deck and hangar deck.

With a biplane it is comparatively easy to fit a jury strut between the upper and lower planes at the position of the front wing spars, and hinge the wings on their rear spars. When, however, the same process is attempted with a cantilever monoplane, the added complications of retractable undercarriages and gun controls in the wings make the problem much more difficult. Blackburns, in the Skua and Roc, solved the problem by hingeing the rear spar on a ball joint so that the wings could turn and fold backwards and upwards.

How Wing-folding is Tackled

The American Navy authorities have tackled this wing-folding in a totally different manner. Instead of insisting that the fold must come close to the fuselage, they require that sufficient of the wings must hinge upwards to leave a centre section capable of passing through the limits imposed by the lift dimensions. Since it would be almost impossible to perform this operation by hand, mechanical means to lift the wing ends have been incorporated in the wing. These are operated from the cockpit. This arrangement has had the effect of speeding-up deck handling considerably. All the Douglas Devastator torpedo-bombers, and the U.S. Navy-constructed Vindicator dive-bombers, have this arrangement of wing-folding. The wing tips are steadied in the folded position by jury struts attached to the fuselage. With the tips thus steadied and the machines lashed down to the sunken hooks in the deck, the aircraft can quite safely be left on the flight deck while the ship is under way.



U.S. Navy Vindicator dive-bombers with wings folded tied down on the flying deck of U.S.S. *Ranger*. The mid-wing monoplanes with airscrew cuffs are Grumman Wildcats—a later edition of our Martlets—which are said to be capable of 350 m.p.h. The smoke stacks on the right hinge outwards when flying-off is in progress.

U.S.S. *Hornet* is very similar to *Yorktown* and *Enterprise*. The fact that no guns of any description appear to be fitted must be blamed on to the American censor.

RUSSIA'S A.T.C.

Potential airmen of Russia's great youth organisation are seen marching in the famous Red Square in Moscow. The building on the left is the old historical museum and the one on the right the market hall.

They Call It the Ossoaviakhim, and It Has Some 20,000,000 Members

THE inculcation of air-mindedness has been the chief aim of the Ossoaviakhim, and although this Russian youth movement has a wider scope than Britain's Air Training Corps, it approximates to it in respect of preparing the country's youth for service with the air forces. Some of its activities are described in this article.

RUSSIA'S youth is air-minded. Flying in the Soviet Union is not just a recent development of her armed forces; it is not just a sport limited to those who can afford it. During the past 15 years the Russian Government has maintained a non-stop campaign of propaganda to make the Russian masses conscious of the importance of flying for both defence and communication.

In a network of flying schools stretching from the White to the Black Sea, from the North Pole to the Pacific, Russia's enthusiasts could, at the expense of the State, learn the arts of gliding, flying, parachuting and aircraft maintenance. Lectures, demonstrations and films brought flying to the fore of public interest. Outstanding pilots and navigators were the first to be awarded the highest decorations. What the gossip or sports column is elsewhere, the aviation page is to the factory girl or clerk in Russia.

Flying has, indeed, become as integral a part of Russian life as tea-drinking or cricket in this country.

Contact with Flying

The results of this drive are of paramount importance. For the close contact of wide masses of the population with aviation and its military aspects is a valuable psychological armour against the shocks experienced by the civilian under conditions of modern air warfare. Moreover, from the vast reserves of keen, trained or semi-trained young men, Russia can draw almost as inexhaustible a supply of personnel for her Air Forces, as for her armies from the masses of the general population.

Foresight in the development of strategy has induced the Russian authorities to persist in this drive towards the popularisation of flying. Rightly, it was recognised that it is the Air Force more than any other branch of the fighting forces for which skilled reserves have to be built up in a slow and thorough process. To build up such reserves of potential airmen already in peacetime, aviation had to be established on as broad a basis as possible, while at the same time drawing the best elements of youth into its orbit.

The *Ossoaviakhim*, the voluntary mass public organisation with some 20,000,000 members, forms this broad basis of Russia's flying personnel. The purpose of this society is to train workers, employees, intellectuals, students and farmers in various branches of military specialities—in particular, flying and chemical defence.

WINNING SMILES. This cheerful group of Soviet fighter pilots, snapped on active service, shows what a fine type of young Russian the *Luftwaffe* is up against. Their smiles show which side is winning.

RUSSIA'S A.T.C.

The entire flying movement throughout Russia is under the auspices of this society, with special emphasis on training in parachuting and gliding.

Training

Criticisms of the alleged low standard of training in the schools maintained by the society have been frequent. But the *Ossoaviakhim* is not a military organisation. Whatever the standard of training, the very fact that millions of young Russians are passing through its ranks is in itself a contribution of primary value towards Russia's air potential. The mere "acquaintance" with the complicated flying technique and equipment—even a very elementary tuition—enlarges the circle from which the Soviet Air Arm can draw its personnel. In a country like Russia, where mechanisation is only of recent date, this growing familiarity of wide masses with mechanical equipment is even of more importance to the development of the air potential than elsewhere.

The training of the *Ossoaviakhim* begins at a very early stage. Over 1,000,000 elementary-school children receive instruction in construction of models and elements of flight. Subsequently they go over to more realistic training, mostly parachuting. Prospective parachutists are subjected to a rigid medical examination, and only those with perfect sight, lungs and heart are accepted. Instruction starts in the early teens, and is divided into two classes, for initial and advanced training.

In the initial stage of parachuting training, the pupils jump with already open parachutes suspended from towers. This helps to overcome the fear which at first sets in, in the uninitiated. Towers for children are 15-18ft. high, those for adults about 100ft. The next stage in training in jumps from moving aircraft, the height of the descent being gradually reduced. The object of this is to achieve, as far as possible, "spot landings" which allow the rapid grouping together in mass-descents. Delayed-drop jumps are practised to reduce the dispersal of the jumpers. Repacking of parachutes is a part of the curriculum.

LEARNING HOW. Young Russians in a factory apprentice school where members of the Ossoaviakhim study the mechanical side of things as an essential part of their training, in the same way as do the boys of Britain's A.T.C.

Gliding Clubs

Gliding is recognised as a valuable introduction to the mysteries of the air. Since the first attempts in 1923, it spread all over the country, and clubs and associations have been formed to foster its further development. On Mt. Usun-Syrt (Mt. Klementiev) a Central Gliding School has been created and claims to be favoured with atmospheric conditions equal to those in the German Gliding Centre on the Rhoen.

Prominent Russian aircraft designers showed great in-

POTENTIAL PILOTS. And here is a view of one of the flying schools where future pilots and aircrew of the Soviet Air Force get their first taste of the real thing.

RUSSIA'S A.T.C.

A PRE-WAR EVENT. Twenty Russian girls march past the grandstand at a great meeting near Moscow, after having jumped by parachute from the aircraft "Pravda."

terest in gliding and were responsible for the creation of several well-conceived glider types. Foremost among these are the Red Front, designed by Antonov; the Stakhanovite, by Yemelianov; the GN-7, by Groshov; the She-lo, by Sheremetiev; and the G-3 by Gribovski.

Breaking Records

Equipped with these types and encouraged by the Soviet Government, Russian glider pilots, men and women, have reached the high peaks of international records. In 1939 Olga Klepikova flew in a Red Front-7 from Moscow airdrome to Stalingrad, a distance of 735 miles, in 8 hr. 25 min. Another international record was gained by another woman glider-pilot, Eugenia Prochorova, who soared to a height of some 11,000ft. above her starting field.

Such feats testify to the standard of training, skill and quality of design, and are an inspiration to the growing generation of gliding enthusiasts. That these individual performances are representative of the general high standard of gliding is shown by the 1940 gliding competition in which junior glider-pilots covered distances of 400-500 km. The fact that 14 out of 19 records registered with the F.A.I. are held by Russians is the best evidence of the high standard of gliding in that country.

Twenty million Russian homes have that intimate contact with one or another branch of aviation which only personal activity can produce. The fact that all activities of the *Ossoaviakhim* are absolutely voluntary, and strictly limited to leisure time, shows their attraction for the youth of Russia. For this is a hard-working and hard-studying youth

Only genuine keenness and enthusiastic spirit could produce such results as have been achieved.

Theirs is a new type of air-mindedness. Not the passive one, which is forged by the threat or experience of air attacks, nor the one which, bred by the advertising campaigns of air-transport firms, sees in flying a luxurious and rapid means of travel, but a genuine liking for wings and a deep interest in the various branches of aviation.

In the present war this spirit and the nation-wide familiarity with air is of immense value to Russia's striking power; her Air Arm has almost inexhaustible personnel resources in the masses of the air-minded youth.

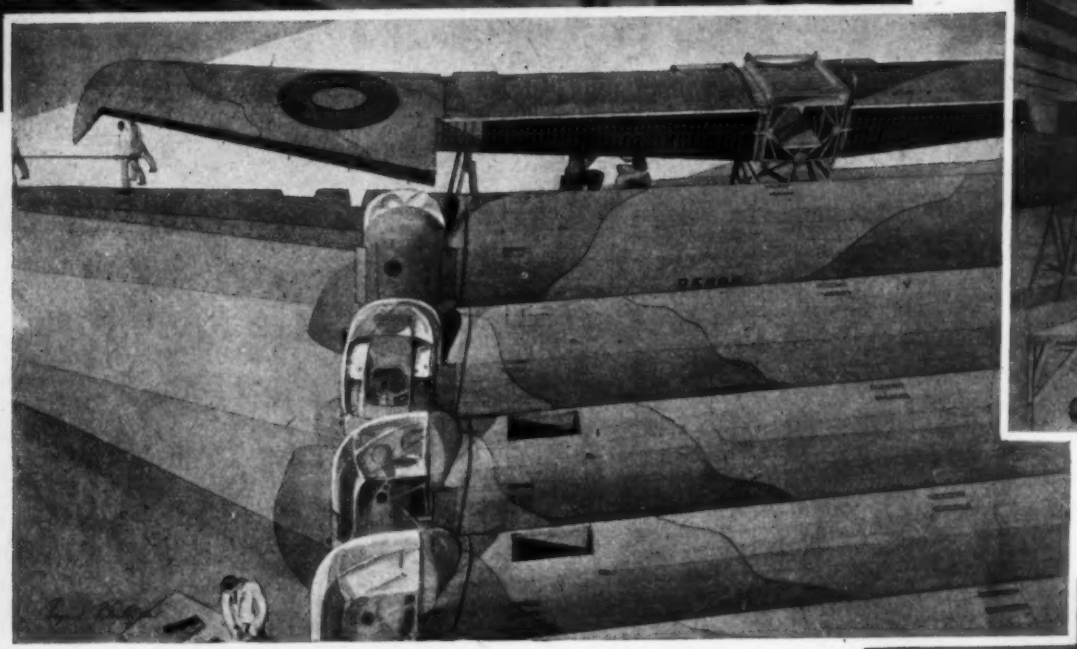
[A fact not mentioned by our contributor is that it was Russia which introduced the system of towing several gliders behind power-driven aircraft. It appears probable that the extensive development of gliding in Russia formed the beginning of this idea. First started as a sport, with single gliders as in other countries, more and more were added, and a whole "train" of gliders were towed. The step to troop-carrying was a logical one.—ED.]

Paratroops were, so to speak, the invention of Russia. Here are a number jumping from an A.N.T.6, with four 680 h.p. M-17 engines.

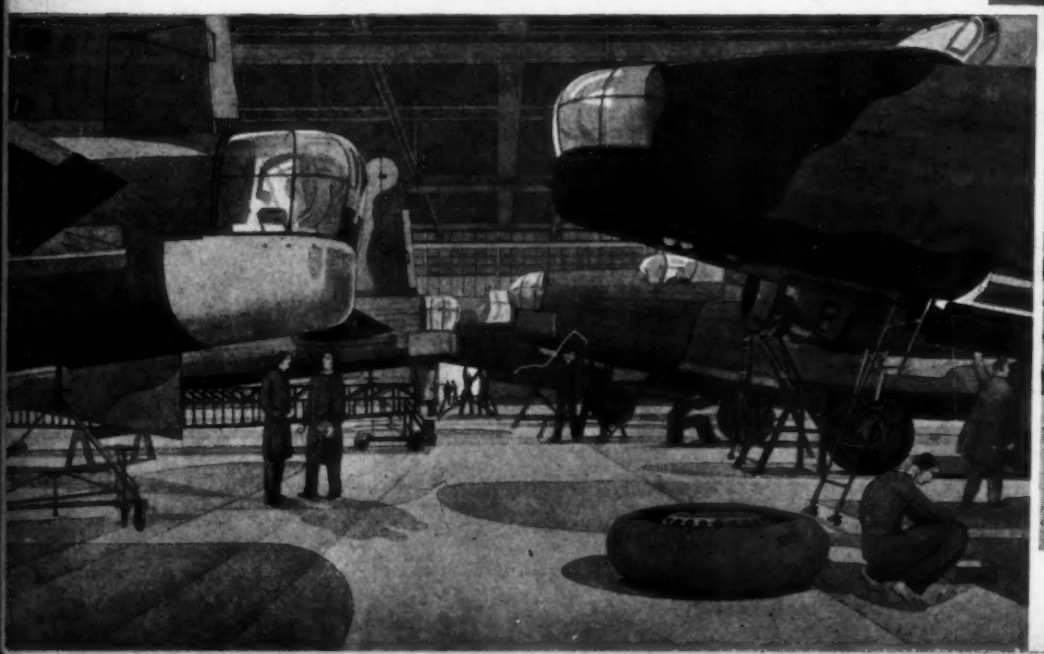
R.A.F.C

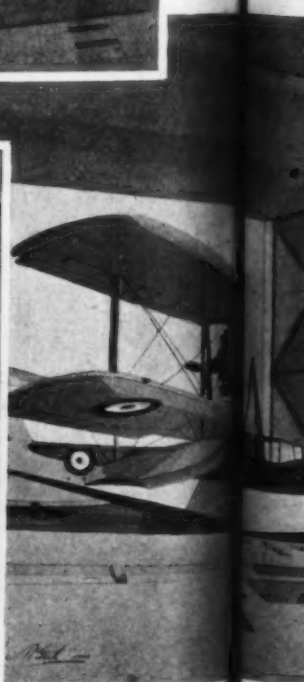
Hangar and Scene

This is the fifth sele cal w



(Above) Whitley Rear Turrets.
(Below) Wellington Front Turrets.

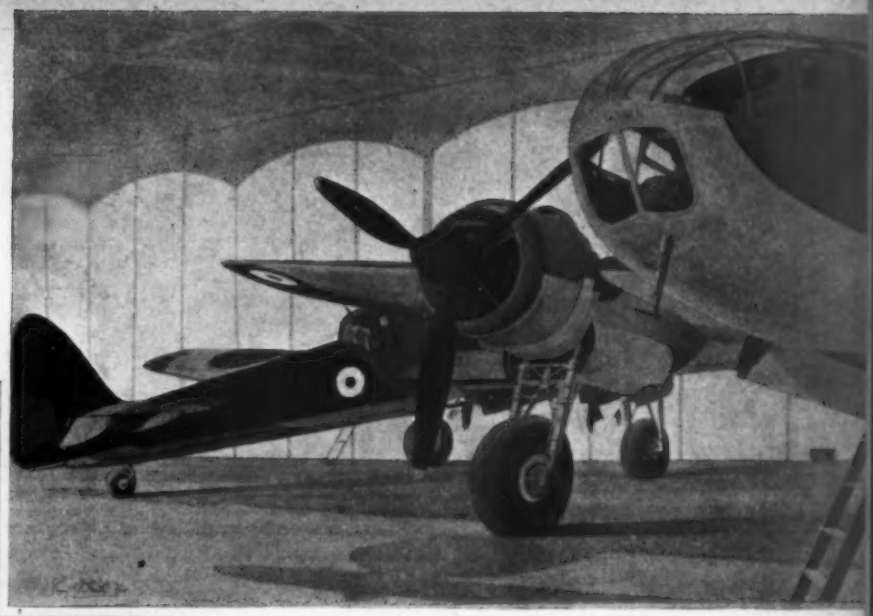




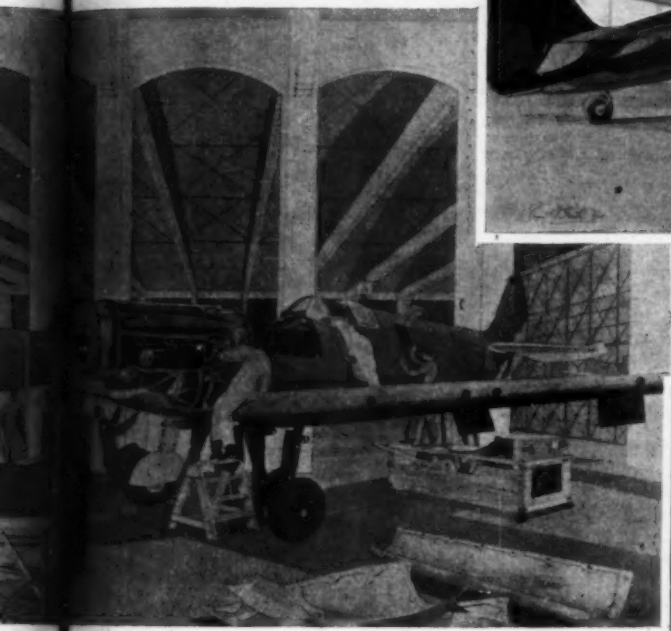
A.R.P. CANVAS

and Scenes from the Brush of d McGrath

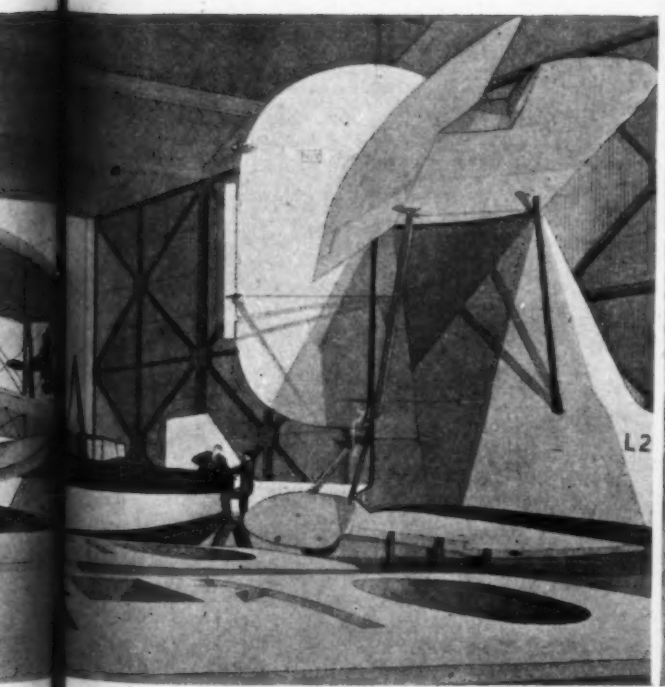
fth selected works by our official war artists

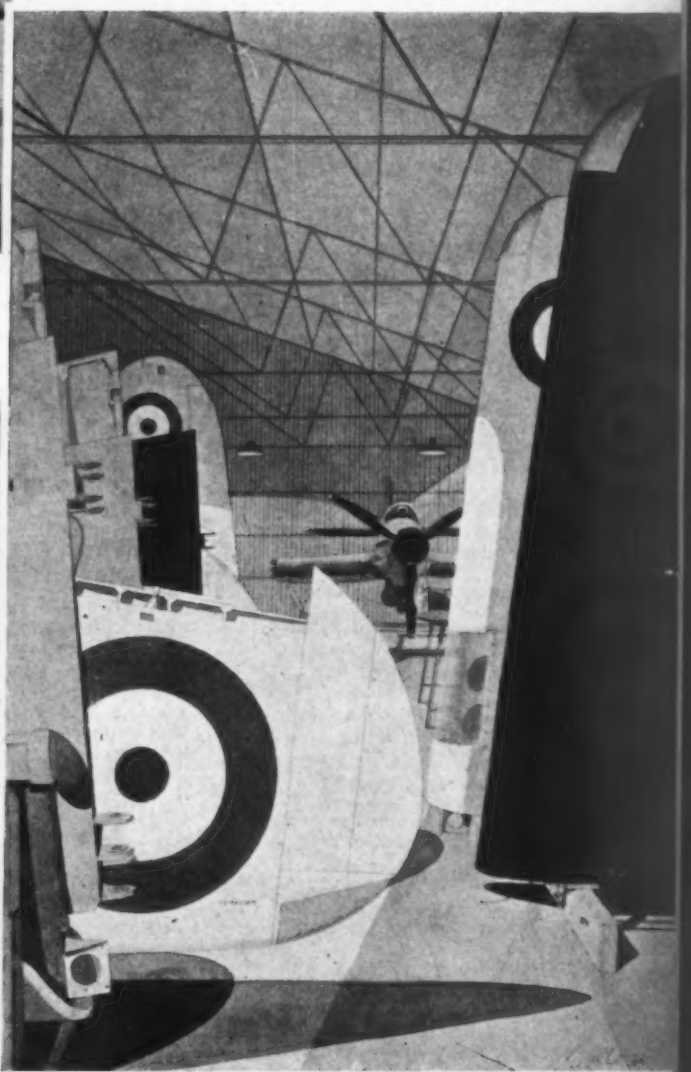


(Above) Beaufort Bombers.
(Below) Training Aircraft under construction.



left) Hangars.
re) Fitters working on a Spitfire.
w) Walrus Amphibian Aircraft.





THREE DIMENSIONAL SEEING

An Ingenious American Device for Increasing Visual Perspective : Alternate Viewing, Persistence of Vision, and Aircraft Speed Utilised

WHEN viewing an object from a great distance the human eyes are incapable of obtaining any substantial degree of visual perspective. In general, a reasonably good perspective vision persists up to a distance of about 500ft. Beyond this, objects tend to appear two-dimensional rather than three-dimensional. For the pilot, crew or passengers of aircraft travelling at high altitude and at high speeds, apparatus which in effect will improve the perspective vision would be of undoubted value. It would, for instance, enable the pilot to obtain a three-dimensional view of the ground, simplifying recognition and being of great assistance in the event of emergency landing on unfamiliar territory.

A device specifically intended for this purpose has been developed by an American company, Bartow Beacons Inc., of Philadelphia. Advantage is taken of the motion of the aircraft relative to the object viewed. The instrument is not effective for stationary observation of a stationary object. It is essential, of course, for the relative motion to be at some angle across the line of vision, and the effect cannot be obtained when the motion of the observer is directly towards the object viewed.

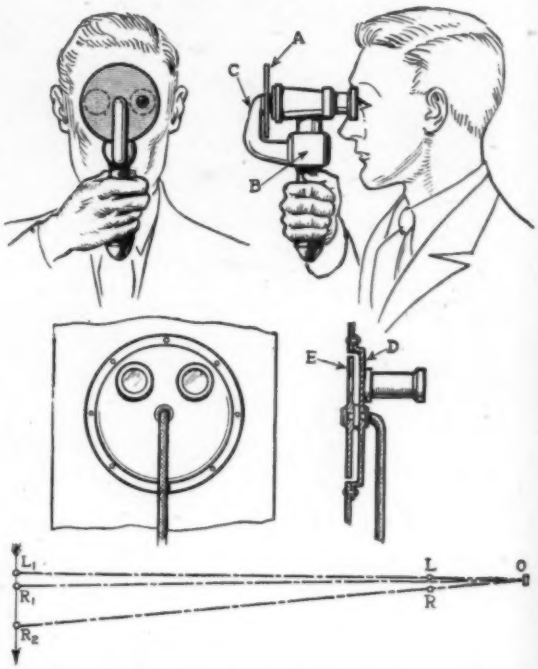
Stereoscopic Angles

In principle the apparatus provides a means for rendering the object visible to each of the observer's eyes alternately and successively, at a frequency within the persistence of vision of the human eye, and with time intervals between successive observations that are long relatively to the periods of observation. As a result, due to the relative movement between observer and object, the eyes view the object successively from points spaced a distance apart which is substantially greater than the normal distance between the human eyes. This may be clearly understood by reference to the diagram at the bottom of the illustration. The object to be viewed is indicated at O and the two eyes of the observer at a distance of 500ft. from the object at L and R. The distance between the eyes, approximately 2½in., is, of course, exaggerated in the diagram in relation to the distance from the object, but this is necessary for the purpose of illustration. At this distance from the object reasonably good perspective is obtained. If, however, the observer is placed, say, 2,500ft. away from the object with the eyes as indicated at L_1 and R_1, the angle of vision is very much reduced and the perspective effect is poor.

Obviously, to restore perspective to the equivalent of that normally obtainable at 500ft. range it would be necessary to maintain a similar angle of vision, which would only be possible if the observer's eyes were separated by a distance of several feet. This, in effect, is the function of the apparatus. With the observer located in an aircraft travelling in the indicated direction, the object is viewed with the left eye at the point L_1, the vision is interrupted and the object is next observed by the right eye at the point R_2, and the same angle of vision is thus maintained. To ensure persistence of vision it is necessary that the successive viewings take place at a frequency of sixteen or more cycles per second.

Alternating Vision

Let us take the specific example of an observer in an aircraft travelling at 180 miles an hour in the direction of the arrow. A view of the object is obtained by left and right eyes alternately at an interval of $\frac{1}{32}$ sec.; that is, each eye has a vision in $\frac{1}{16}$ sec. In the interval of time between successive left eye and right eye views, the aircraft has travelled approximately 8ft. Since the distance between the eyes is about 2½in., the perspective vision



Sketches show portable and built-in types of viewing devices, whilst the lower diagram illustrates the principle employed in the apparatus.

with the aid of the aparatus is thus increased in the ratio of approximately 40 : 1. Stated in another way, the effect is the same as if the observer's eyes were set at a distance of approximately 8ft. apart.

Viewing Devices

Any mechanically operated shutter device could be used but the preferred apparatus employs an apertured rotating disc. In any case binoculars may be incorporated to magnify the image and enhance the effect. The first example illustrated in the sketch is a self-contained portable instrument. A pair of binoculars is supported on a handled structure and adjacent to the objective lenses is an opaque disc A having a single aperture. This disc is rotated at a speed of 16 r.p.m. by a miniature electric motor housed at B. Current for the motor is obtained from dry batteries in the handle, and the drive to the disc is by a flexible shaft contained in the hollow support arm C. Relative to the disc the eyepieces are located at 180 deg. and the disc would not need to exceed 5in. diameter.

The further embodiment shows a viewing device built into the wall of the aircraft cabin. Framing D, carrying the binoculars, is flanged to the skin, and disc E is driven by flexible shaft from a small motor at any convenient adjacent location. It will be noted that the eyepieces are in this instance set at about 90 deg. relative to the disc. For a given speed of aircraft, and assuming the necessary disc speed of 16 r.p.m. to ensure persistence of vision, the perspective effect is obviously less than would be obtained with the 180 deg. location, as the interval between successive views by left and right eyes is reduced. However, this could be restored by providing two apertures at 180 deg. in a disc rotated at only 8 r.p.m.

Twenty-second of the Second Series

FRIEND or FOE?

British and German Comparison : Miles Magister and Ju 87B

MAGISTER. Rectangular, cantilever tailplane. Well-tapered fin and rudder with small round apex and straight trailing-edge. Fixed tailwheel.

ALTHOUGH the Miles Magister and the Junkers Ju 87B (unpopularly known as the Stuka) are both examples of the rectangular tailplane and the almost equally angular vertical surface, they are, of course, in completely different classes. The former is a comparatively small primary trainer, and the latter a dive-bomber of appreciably greater overall dimensions.

Nevertheless, spotters of experience know full well that altitude can have a misleading effect upon apparent size, and so dimensions which may be obvious enough "on paper" are not necessarily an accurate means of identification when the actual machine is seen against the "blue vault of heaven."

Disregarding, therefore, their difference in size, these two machines have a number of points in common which, to the learner-spotter at all events, could lead to initial confusion. Chief among these, perhaps, is their fixed undercarriages and non-retracting tail wheels; and, next in importance, their rectangular tailplanes.

It is true that the Ju 87 has cranked wings, and that this feature is obvious enough from almost any angle except when seen from directly beneath, but it is when seen in plan that the essential difference between their tailplanes is most easily discerned, namely, that the plan of the Miles tailplane is of appreciably lower aspect-ratio than that of the Junkers.

Another useful difference is that the Ju 87 has V struts bracing its tailplane, whereas that of the Magister is of the cantilever type—in passing, one may point out that any idea of associating this "V" with the symbol of victory is nicely negatived by the fact that it is *inverted*.

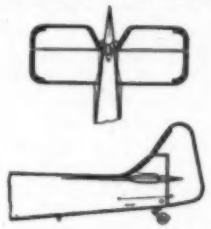
Two other small differences exist between the tailplanes of these rival machines; the tips of the Magister are slightly rounded at the corners, but those of the Junkers are definitely square cut; and the inner corners of the Maggie's elevators are cut away at an angle to permit rudder clearance while those of the Junkers maintain the completely rectangular *motif* of the tailplane.

Turning now to the vertical surfaces, there is a similarity in the line of their respective leading-edges; the fins of both machines form a concave curve where they rise from the fuselage towards the apex. That, however, is where the resemblance ends, for the Maggie has a very small, round apex and a slope to its straight trailing-edge, whereas the Ju 87 has a flat apex of appreciable breadth and a perfectly vertical trailing-edge.

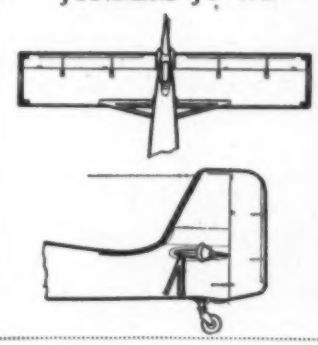
There are, of course, a number of other small features in which the design of these two tail units differ, but they are hardly likely to concern the spotter as such. Reference to the accompanying drawings, for instance, will show that the Ju 87 has mass balances on its elevators which project, quadrant fashion, across the tailplane tips; the smaller and lighter elevators of the Magister call for no such provision.

Next week: Fokker T.8W. and Heinkel He 115.

MILES MAGISTER



JUNKERS JU 87B



JU 87B. Rectangular V-strutted tailplane; elevator mass-balances, high aspect ratio. Broad, flat apex to fin and rudder, straight vertical trailing-edge. Fixed tailwheel.

SUPERCHARGERS

Part II of an Article on their Design and Construction : In this Issue: Constructional Materials, Design, and Performance Measurements

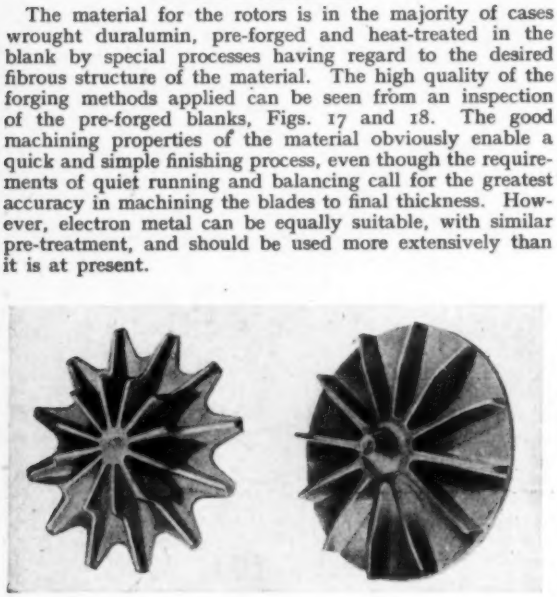
By W.v.d.NULL and H. PFAU

(*Continued from page 54*)

SILUMIN or electron alloy are used for casting blower casings, the thickness being from 3 to 10 mm., depending on the design stresses and the type of ribbing. The guide vanes can be cast integrally with the casing and machined, or made separately, in which case steel is frequently used. In shaping the casings, attention should be paid to the temperature stresses. The temperature at the intake can be as low as −56 deg., and at the discharge as high as 180 deg., depending on the flying height, compression ratio, and efficiency. In mass production, the various highly developed pressure-casting processes can be applied.

Rotor Materials

The material for the rotors is in the majority of cases wrought duralumin, pre-forged and heat-treated in the blank by special processes having regard to the desired fibrous structure of the material. The high quality of the forging methods applied can be seen from an inspection of the pre-forged blanks, Figs. 17 and 18. The good machining properties of the material obviously enable a quick and simple finishing process, even though the requirements of quiet running and balancing call for the greatest accuracy in machining the blades to final thickness. However, electron metal can be equally suitable, with similar pre-treatment, and should be used more extensively than it is at present.



Figs. 17 and 18. Dürener Metallwerke pressed light-metal alloy blanks for semi-shrouded impellers.

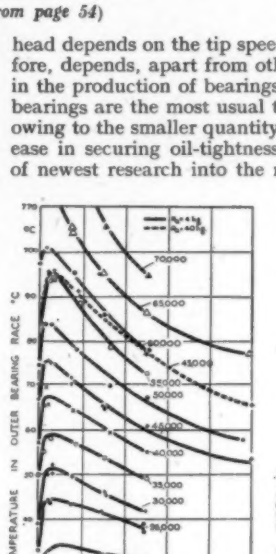
Impellers are occasionally machined from the solid, out of pre-forged alloy-steel blanks; the disadvantages are high first cost, and weight. It may be necessary to use steel in the rotors and guide-vanes on account of a tendency of the engine to backfire into the induction piping, and therefore into the blower.

The rotor shafts are steel, solid or hollow, with diameters between 15 and 65 mm.

Bearings

The bearings are usually roller bearings, radial loads being taken up by rollers or single-row ball bearings, and the axial thrust by angular ball bearings. In some cases the rotor shafts, whether overhung or doubly supported, are carried on three roller bearings, of which one is an angular bearing with radial play towards the casing, exclusively absorbing the longitudinal thrust. Journal bearings with fixed or floating bushes are to be found only in a few types—usually foreign. Roller bearings are either pressure-lubricated, or splash-lubricated from the neighbouring gear-wheels.

Reduction in the blower dimensions can only be effected by increasing the revolution speed, since the attainable head depends on the tip speed. Blower development, therefore, depends, apart from other factors, on further research in the production of bearings to run at high speeds. Roller bearings are the most usual type in aircraft-engine blowers, owing to the smaller quantity of oil required and the greater ease in securing oil-tightness. Fig. 19 shows some results of newest research into the relationship between the lubricant fed to the bearing, Q, and the temperature of the outer bearing ring, furnished by the DVL. These tests have been made at revolution speeds already much in



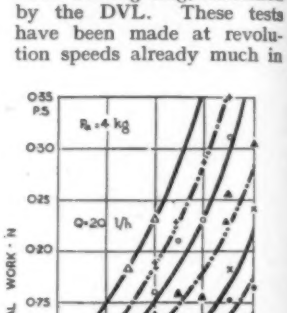


Fig. 19 (left). Relationship between temperature in the outer ball-bearing race and quantity of lubricant, Q. Fig. 20 (right). Relationship between frictional work, N, speed of revolution, *n*, and quantity of lubricant, Q.

advance of those used on present-day bearings. Tests of the same nature are now being carried out on the power-loss in bearings, Fig. 20; this proves to be in parabolic relationship to the running speed, with an exponent nearer two than three, in the case of a constant oil-feed, and is probably due principally to pumping losses.

Volumetric Efficiency

In the design of aircraft-engine blowers, attention must be paid to the type of engine for which the blower is intended, and the proposed method of regulation. The volumetric efficiency of the blower is conditioned by the stroke volume, running-speed, and back pressure values of the engine. Aircraft-engine blowers being as yet uncooled, the head is determined by the expression:

$$H_{ad} = \frac{\chi}{\chi - 1} \cdot R \cdot T_1 \left[\left(\frac{p_2}{p_1} \right)^{\frac{\chi - 1}{\chi}} - 1 \right] \qquad (1)$$

wherein:

p_2 = required blower delivery pressure
p_1 = blower entry pressure at rated height
T_1 = intake temperature
χ = adiabatic exponent
R = gas constant.

Present-day practical values for p_2 lie between 1 atm. and 1.8 atm. acs. Hitherto all leading designs of aircraft-engine blowers have provided for straight radial blades; the adiabatic efficiency factor q_{ad} for the intended blower can therefore be selected from empirical values, e.g., from the data given by the DVL for 313 individual cases—see

SUPERCHARGERS

Fig. 21—and the required tip speed u_2 of the impeller, obtained from the equation

$$gH_{ad} = q_{ad}\, u_2^2 \quad \ldots\ldots\ldots\ldots\ldots \quad (2)$$

A succession of further empirical factors are required to fix the dimensions of the impeller—in particular, a suitable diameter ratio D_2/D_1 (good results have been obtained with a ratio of $D_2/D_1 = 1.4 - 2.0$, see Fig. 14); and the ratio of the meridian flow velocity c_m to the tip speed u_2 for which a suitable limit is $c_m/u = 0.35 - 0.60$. The blade-width at the impeller discharge is obtained from the condition of continuity, a suitable basis for design, allowing for the thermodynamic state-change in the flow through the blower, being the assumption of a constant rate of increase of the meridian component of the absolute velocity between intake and outlet; suitable efficiency can be ensured by keeping the design values at the mean of the limits given. Limitation of the running speed owing to peculiarities in the driving mechanism, e.g., a gear-drive of known efficiency, or an exhaust turbo-drive, can easily be adjusted within the stipulated limits of the above ratios.

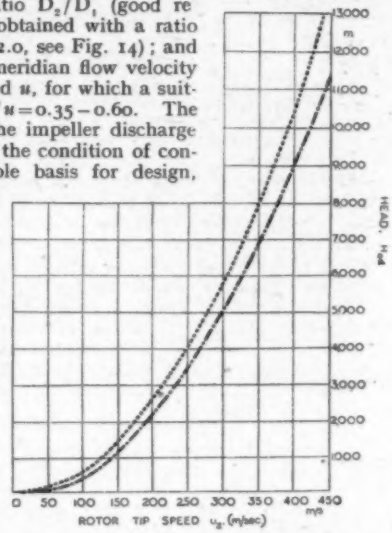
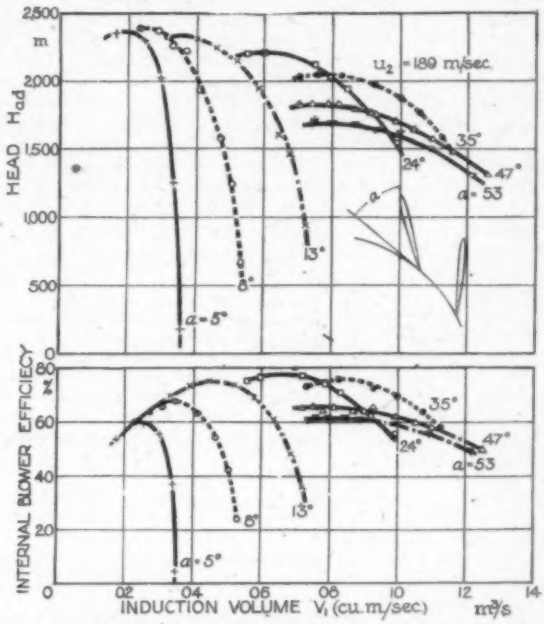


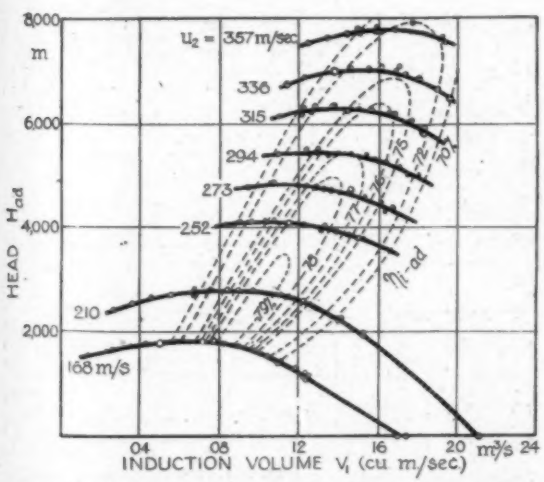
Fig. 21. DVL measurements for the head H_{ad} at the point of optimum efficiency, in relation to the rotor tip speed u_2 for aircraft engine blowers with radial blades. Averages of 313 measurements.

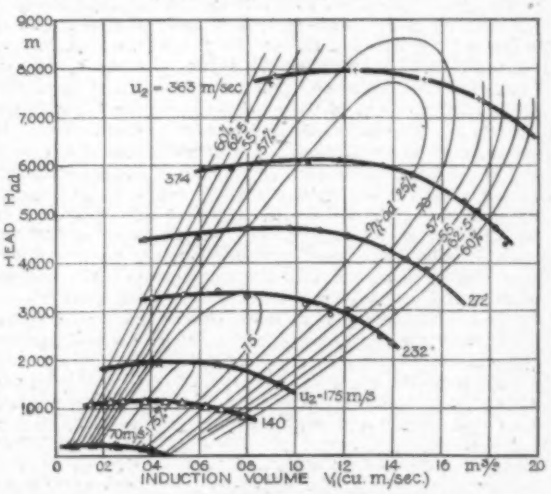
The setting angles of the entry impeller blades and diffuser vanes and the dimensions of the volute casing can be determined from the ratio of flow velocity to tip speed. Blowers without diffuser vanes can have smaller casing diameters and are thus more convenient to instal. They should be used principally for higher flow velocities, i.e., higher specific running speeds. Their q_{ad} values are always lower than when guide-vane diffusers are used. The characteristic curves of blowers with vaneless diffusers can be made very flat. Fig. 22 shows the characteristics of a



Figs. 24 (top) and 25 (bottom). Characteristic curves of a DVL experimental blower with adjustable straight-exit vanes. a = inclination of guide-vane median lines to the direction of the periphery.

DVL blower with an exit volute, an impeller diameter ratio about 1.65, and a short-radius annular clearance space, at average flow velocities. Fig. 23 shows similar curves for a DVL blower with a large rotor-diameter ratio, relatively large radial clearance, and high flow velocity. These curves have a particularly flat gradient and the blower





Characteristic diagrams of DVL blowers. u_2 = rotor tip speed; η_{i-ad} = internal blower efficiency. Fig. 22 (left): Blower with single-exit spiral volute without exit vanes and of small radial extension. (See also Fig. 12 in last week's issue.) Fig. 23 (right): Blower with single-exit spiral volute without exit vanes and large annular diffuser between rotor and volute casing.

SUPERCHARGERS

shows little tendency to instability, even with a low discharge volume. A peculiarity of such blowers is the increase in efficiency as the tip-speed decreases.

Diffuser Vanes

Blowers with diffuser guide-vanes are most suitable for low velocity of flow, i.e., low running speed. Fig. 24 gives the curves of a small DVL experimental blower with straight, adjustable diffuser vanes, at a constant tip speed. At small guide-vane angles the possible head, i.e., the q_{ad} value is high, and the efficiency low—see Fig. 25. With increasing blade angle "a" the suction volume mm.³/sec. increases owing to the increasing channel width, but the head is not affected immediately. The possible maximum efficiency increases somewhat rapidly and attains its maximum at $a \sim 24$ deg. Further increase in the blade-angle causes a rapid drop in the head and maximum efficiency and no change in the throughput volume. This discontinuity in the steady development of the head and efficiency values may be attributed to the effect of the unchanged entry impeller; as the intake volume increases beyond an amount defined by the intake section of the entry impeller, an undesirable and harmful velocity increment is produced, followed by retardation, which presumably explains the observed deterioration in the values of pressure head and efficiency.

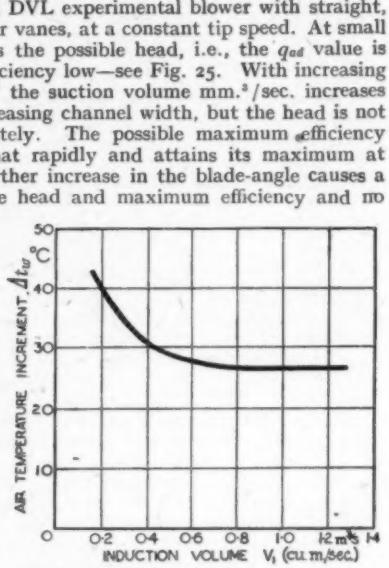


Fig. 26. Air-temperature increment Δt_w in the blower against volume of flow for all measurement points of Figs. 24 and 25.

Blower Efficiency

The internal blower efficiency η_{i-ad} is represented by the ratio of compression work done to power absorbed. The power consumption per unit rate of flow is proportional to the effective temperature increment Δt_w. Fig. 26 shows all measured values of Δt_w for the results of Figs. 24-25, plotted as ordinates against the suction volume V_1. All lie in one fair curve. The unit power consumption of the blower is thus independent of the guide-vane setting. The initial appreciable diminution in the rate of temperature rise with increasing suction volume, together with the small rate of fall of the head, consequently explains the increase of efficiency at larger angles of the guide-vanes. The decrease in the rate of temperature-rise, together with other factors, indicates a loss of energy between the impeller and the diffuser, which becomes increasingly apparent as the suction volume increases, until the temperature curve assumes a horizontal course, as could be expected from consideration of the conditions in a rotor with straight radial blades (29). If, within this range, the effective head falls still further, the efficiency must inevitably fall. In rotors having more blades than the eight-bladed impeller used in these tests, the values of the temperature rise along the horizontal portion of the curve will be greater.

An empirical factor:

$$q = \frac{\Delta t_w \, c_p \, g}{A \, u^2_2} \qquad \ldots\ldots\ldots\ldots \quad (3)$$

can be used as a check on these values; it represents the ratio of effective work done by the rotor, $\Delta t_w \, c_p / A$, to the theoretical work of a rotor with an infinite number of blades, u^2_2/g; c_p is the specific heat, and A the mechanical equivalent of heat. The internal efficiency of the blower is represented by:

$$\eta_{i-ad} = \frac{A \, . \, H_{ad}}{c_p \, \Delta \, t_w}$$

Introducing Eq.2 and the numerical factors for air, this becomes:

$$\eta_{i-ad} = \frac{A \, . \, q_{ad} \, u^2_2}{g \, c_p \, \Delta \, t_w} \approx \frac{q_{ad} \, u^2_2}{1{,}000 \, \Delta \, t_w} \qquad \ldots\ldots \quad (4)$$

and by Eq. 3 and 4:

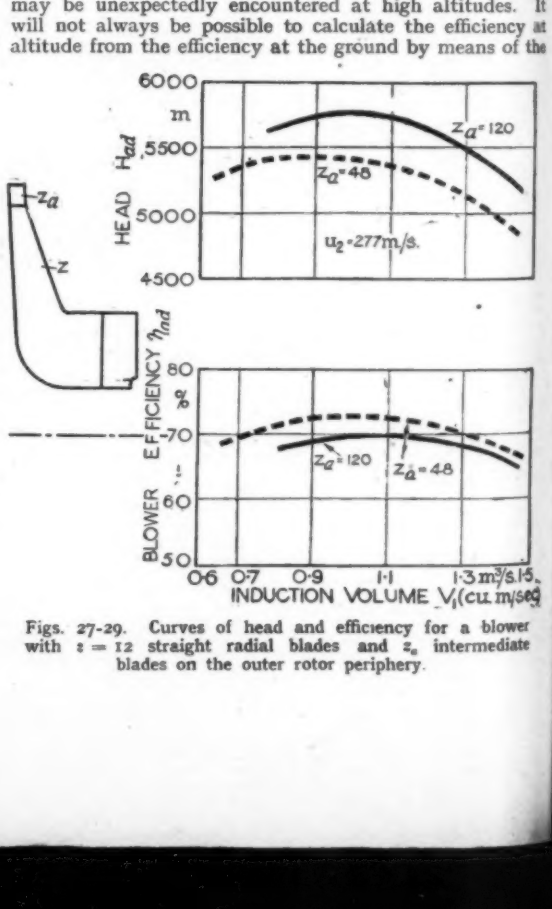
$$q \approx 1{,}000 \, \frac{\Delta \, t_w}{u^2_2}$$

In the present case of a blower with adjustable guide-vanes, the value of "q" over the horizontal branch of the curve is $q = 0.764$. For the smallest guide-vane angle examined, $q = 1.05$ at maximum efficiency. It is thus possible directly to define the specific running speed of the impeller by means of this empirical factor.

It has also been found in other cases, that the intake volume at maximum efficiency increases with increasing breadth of the entry passages of the impeller; similarly, the efficiency itself perceptibly increases with increasing specific running speed, as shown in Fig. 25.

Blower Experiments

Blower experiments are usually carried out with suction direct from the atmosphere, i.e., at an intake temperature of about +15 deg. When testing on high-altitude test benches, or in flight, considerable divergence may be found between the results so obtained and the figures for ground-level conditions. The congruence and affinity between the running-speed curves at low tip speeds cease to exist at widely differing suction temperatures and higher values of u_2. Neither the experimental results hitherto obtained, nor their theoretical interpretation, afford any clue to this, as yet. Both decreasing head and falling efficiency, and the reverse, have been found to exist with falling suction temperatures. These show that in designing blowers for a large head the efficiency when working on cold air should also be determined, since otherwise engine trouble may be unexpectedly encountered at high altitudes. It will not always be possible to calculate the efficiency at altitude from the efficiency at the ground by means of the

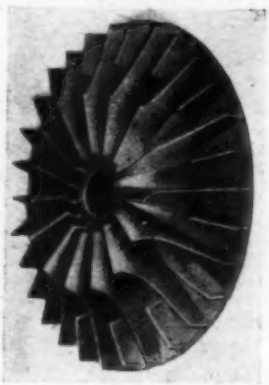


Figs. 27-29. Curves of head and efficiency for a blower with $z = 12$ straight radial blades and z_a intermediate blades on the outer rotor periphery.

assumption of equal heads, since the reduction in temperature of the entering air will in the majority of cases cause a decrease in the value of the head at altitude, with deficient charging pressure and consequently insufficient engine output.

As already stated, the ratio of the effective delivery head H_{ad}, to the theoretical maximum head, H_{th}, is largely determined by the number of blades in the rotor. The difference between these values is explained by the following: first, the divergence of actual flow paths from the theoretical paths defined by the form of the blades; secondly, the effect of friction in the flow passages. In the first case, the obvious remedy is to increase the number of blades; however, owing to the consequent increase in the blade surface area this may increase the frictional resistance. This condition is indicated in Figs. 27-29; the rotor has "z" complete blades and "z_a" removable intermediate blades extending over only part of the radius, in the discharge zone of the rotor. Figs. 28-29 show the results obtained with an identical rotor at z_a = 48 and 120. For the smaller number of blades the head is some 6 per cent. less, while the efficiency is about 4 per cent. greater. The test proves the existence of the theoretically increased head and the unfavourable effect on efficiency of increasing the number of blades.

Intermediate blades, although of somewhat greater radial length, and in smaller number, have already been applied in static centrifugal compressors, and also been tried in aircraft engine blowers, (Fig. 30). The maximum tip speed is, of course, less than for a rotor without intermediate blading. In view of the usually unfavourable influence of an increased number of blades on the efficiency of the blower—whereas aircraft engine blowers obviously require the maximum possible efficiency—and the fact that the increased head can be easily obtained by slightly increasing the tip speed, it appears at first doubtful whether the provision of additional blades is really advisable.



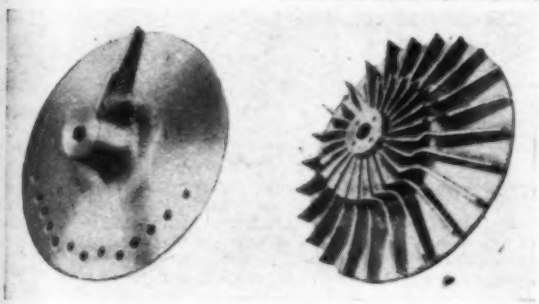


Fig. 30 (right). B.M.W. blower rotor with intermediate blades on the outer periphery. (Below) Experimental rotors of the DVL. Fig. 31 (left) : Least number of blades, $z = 1$. The unbalance due to the single blade is compensated by heavy metal rivets. Fig. 32 (right) : Greatest number of blades, $z = 24$. The blades were milled consecutively and symmetrically out of the solid.

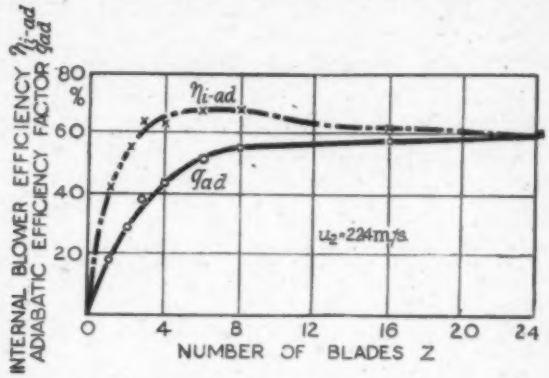
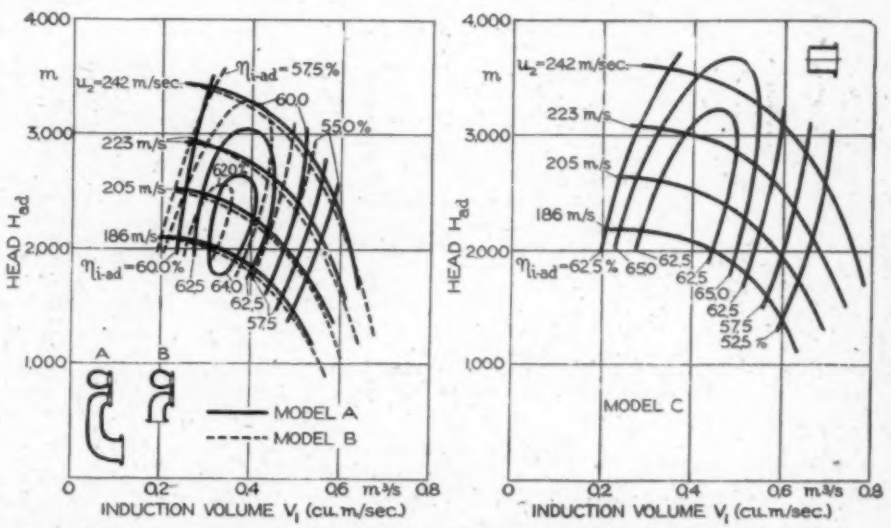


Fig. 33. Maximum internal blower efficiency η_{i-ad}, and adiabatic efficiency factor q_{ad}, against the number of blades, z, for the rotors of Figs. 31 and 32. These results are not applicable to any arbitrary blower design.

In any case, the question of the optimum number of impeller blades for given conditions is of greatest importance. Figs. 31 and 32 show two impellers, with the smallest and the greatest number of blades respectively, of the number tested by the DVL on the special rotor used in a series of experiments on the influence of the number of blades. The curves of the corresponding maximum values of η_{i-ad} and q_{ad} are plotted in Fig. 33 for u_2 = 224 m/sec. These results, which indicate 6 to 8 blades as the optimum, should be accepted with reserve. For a single blade the effective cross-sectional area of the intake is a little more than 98 per cent. of the area of a free annular cross-section of the same diameter, whereas in the rotor with 24 blades this proportion is only 56 per cent.; i.e., with equal inflow velocity, the intaken volume will only be 57 per cent. of that in the first case. There is a further disadvantage in the fact that the spiral volute of the blower was identical in all cases tested, so that the volume of "shock-free"



Figs. 34 and 35. Characteristic curves of the same DVL experimental blower, differing only in the form of the entry pipe as shown. The rotor is of the design shown in Fig. 36, and is provided with an entry impeller. The experimental blower was identical with that of Fig. 33.

SUPERCHARGERS

entry did not correspond for the impeller and the volute; the influence of this factor being further enhanced by the fact that with varying head the change in volume between the impeller entry and the commencement of the volute varies according to the number of blades. It is therefore difficult to arrange the experiment in a manner to define the separate influence of the number of blades; however, the tests do show that a smaller number of blades than usual is practicable, and in certain cases more favourable than increasing the number of blades.

It remains to underline the importance of the number of blades in connection with the first cost and weight of the blower, and particularly the bearing loads produced by centrifugal forces. Obviously, it is cheaper and simpler to machine a smaller number of impeller blades.

The question of the most suitable design for the intake to the blower (casing inlet) is particularly debatable. This apparently subsidiary component of the blower can have a disproportionate effect on the installation of the power-unit in the airframe. Casing inlets can be: straight axial, single or multiple intake pockets, single or multiple intake manifolds. Figs. 34 and 35 show three curve-charts explaining the influence of the above-mentioned inlet types on the characteristics of the blower. In cases A and B, Fig. 34, the curves for similar tip speed differ only slightly, and in case B the efficiency is even 2 per cent. less than in case A. In the straight axial intake of case C, Fig. 35, on the other hand, the curves of equal tip speeds are considerably flatter, i.e., a larger throughput is possible, and the efficiency is greater by some 4 per cent. In all three cases, pressures in advance of the casing inlet were measured at approximately the same distance from the impeller entry along the central line of the flow. The improved result obtained with a straight axial intake is probably due principally to the decreased throttling effect of a straight entry. Furthermore, the flow entering through an intake pocket or manifold is probably not entirely free from twist, and the entering flow is consequently not evenly distributed over the cross-section. The difference is, however, not great.

More recent experiments indicate that intake pockets, if amply dimensioned and properly shaped, even if the axial length is restricted, are relatively little less favourable than a straight radial intake. The correct mathematical evaluation of such casing inlets is not yet defined; relatively slight modifications in form can have a great effect; particular care should be taken to secure freedom from twist and an evenly distributed flow on the impeller. The absolute air velocity will probably also exert a certain influence at the impeller entry—earlier tests of intake pockets also showed the efficiency to be some 3-5 per cent. less than for a straight axial intake. However, for reasons connected with the installation on to the aircraft, straight axial intakes are not usual. In a number of cases the casing inlet has been designed as a normal volute, the entry rotor being omitted and the impeller having straight radial blades.

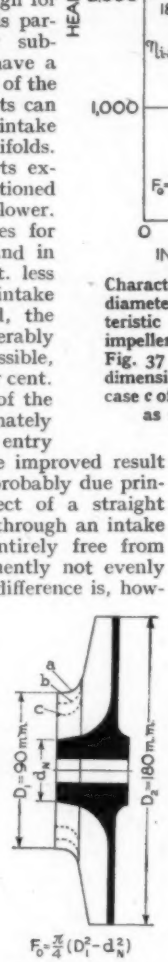
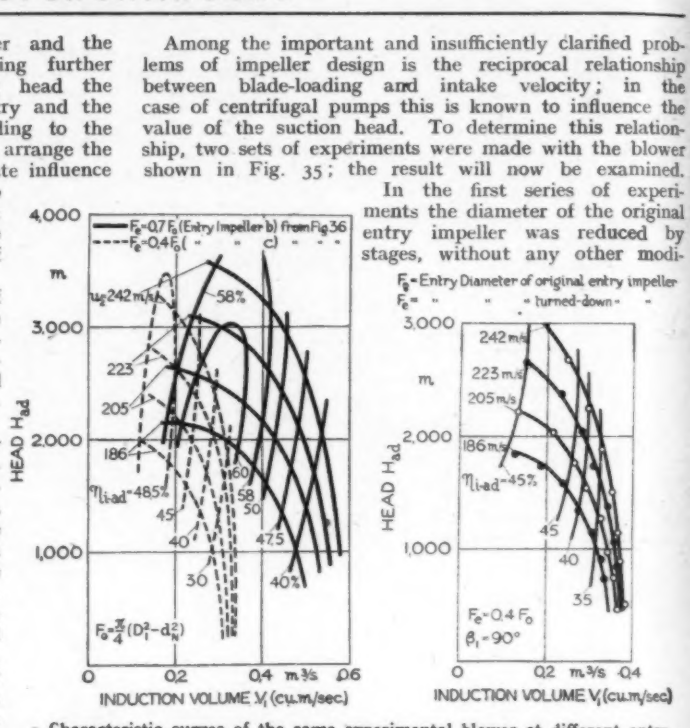


Fig. 36. Experimental rotor with different diameters of entry impeller.

Among the important and insufficiently clarified problems of impeller design is the reciprocal relationship between blade-loading and intake velocity; in the case of centrifugal pumps this is known to influence the value of the suction head. To determine this relationship, two sets of experiments were made with the blower shown in Fig. 35; the result will now be examined.

In the first series of experiments the diameter of the original entry impeller was reduced by stages, without any other modification of the blower (Fig. 36). The characteristic curves for 70 per cent. and 40 per cent. of the original intake area of the rotor, corresponding to "b" and "c" of Fig. 36, are shown in Fig. 37. The measurements showed the suction volumes V_1 for η_{max} to be in the ratio of



Characteristic curves of the same experimental blower at different entry diameters of the entry impeller and varying blade design. The characteristic curves of the experimental blower in the original form (entry impeller as shown at *a*, Fig. 36) had the characteristics of Fig. 35. In Fig. 37 (left) the full lines apply to an entry impeller turned down to the dimensions of case *b*, Fig. 36. The dotted lines are for the dimensions of case *c* of that Figure. In Fig. 38 (right) the curves apply to an entry impeller as *c*, Fig. 36, but with straight radial instead of curved blades.

An experimental French blower. Fig. 39 (left) shows it to be of semi-shrouded type, with subdivided entry impeller. Fig. 40 (right) shows the exit diffuser of the same blower, with subdivided vanes.

1 : 0.73 : 0.375, instead of the theoretical ratio 1 : 0.7 : 0.4. The difference is inconsiderable in view of the flat gradient of the curves of η with respect to the suction volume at n = const., particularly since the volute spiral was not modified, which somewhat reduced the value of these experiments. For an intake area of $F_e = 0.7\ F_0$, the value

of H_{ad} at η_{max} was found to be the same as for the original area F_o; at $F_e = 0.4F_o$, a slight decrease was observed, doubtless due to the above-mentioned factor limiting the validity of comparison.

In the second series of experiments, a separate entry impeller was provided for each reduced intake diameter, the blade-setting angles being increased to furnish a theoretically constant suction volume. However, instead of a ratio of 1 : 1 : 1, the suction volumes V_1 were found to be in the ratio 1 : 0.82 : 0.50. Thus, if all other blower dimensions remain constant, it is impossible to obtain an increase in the intake velocity despite the fact that the dimensions of the volute are now correct for each case. The observed variation of the head was almost the same as in the preceding case.

To complete the investigation, characteristic curves were also plotted for a cross-sectional area $F_e = 0.4\ F_o$, with an entry impeller blade angle of $\beta_1 = \text{const.} = 90$ deg. on all diameters (see Fig. 38). As the pumping limit was reached it was impossible to determine if the maximum efficiency had been attained or not. In all experiments with entry impellers of different diameters the main rotor itself remained unchanged. Although this simplified the arrangement of the experiment, it probably had an unfavourable effect owing to the double transformation of velocity. Further experiments will be needed, gradually eliminating these drawbacks, which impair the validity of the result.

The blades of the Szydlowski-Planiol supercharger, a French design for the Hispano-Suiza engine, are of an exceptional type. Fig. 39 shows the rotor, and Fig. 40 the diffusor vanes of this blower, of which, presumably, a number of experimental units are in existence. The blade form appears to be based on the principle of removal and renewal of the boundary layer based on the theory of the slotted wing. A special claim, as yet untested, is made that this blade-form assures constant rate of increase of the adiabatic efficiency factor q_{ad}, and the indicated adiabatic efficiency η_{iad}. The available published results show no distinguishable advantage. By DVL tests, the adiabatic efficiency factor at a tip speed of about 300 m/sec is of the order of $q_{ad} \approx 0.67$, and the internal efficiency therefore η_{iad} 0.79. In application to the Hispano-Suiza engine, however, the new blower probably represents a considerable advance, since the standard blower provided for that engine had an unsatisfactory performance.

Clever but Impractical

The designers of this blower, in recapitulating its advantages, lay particular stress on the indifference of the "fish profile" (by which the particular blade-shape of the entry impeller is meant) to appreciable fluctuations in direction of the incident flow, produced by the special method of regulation. The Szydlowski-Planiol supercharger is particularly carefully designed. Even if this blade form should offer some advantages, it is hardly suitable for general adoption on account of difficulty of manufacture, first cost and maintenance. Furthermore, this type of blade will be particularly liable to damage; if the engine backfires, the diffuser vanes will assuredly be fractured. The subdivided blades of the entry-impeller also produce an increase in the axial length of the blower. The overall dimensions of the blower, however, are not unfavourable.

POST-WAR AIR LINES

Capt. H. Balfour's Views on the Future of Civil Flying : A Bold Government Policy Essential

"THE biggest job of post-war world reconstruction will be building up air communications," said Capt. Harold Balfour, Under Secretary of State for Air, when addressing the Overseas League at a recent lunch. "The greatest opportunity for adventure and achievement on the part of young men of the world," he added, "will lie in this field."

The British Commonwealth of Nations depended for its strength on unity, and unity on ability to meet, talk and trade with each other. The strength of the British Isles, as the centre of the Commonwealth, rested only upon the fact that it was the capital. We must link up the centre to the outlying nations; the outlying nations must link each to the other. Then, alongside and co-operating with the other free nations of the world, we could girdle the globe with a ring of civil air fleets, flying for peace but protected by strength.

Saying that war had not killed civil air communications but had only diverted them from peacetime commercial aims to service in the war effort, Capt. Balfour pointed out that our civil communications linked up to America, Africa, Egypt, India, Australia and New Zealand, and were all kept going regularly; they also extended to Scandinavia, and now to Teheran and Russia.

"Open Sky" for Democracy

Their peacetime future depended upon a Government policy of bold, swift decisions.

"We shall have to be big and bold in our thinking and planning and in our spending," he said, "if the post-war world of air communications, as of other things, is to be built on the philosophy of plenty."

We needed an Imperial policy which would dovetail into a world policy. British air routes should run in co-operation and partnership with he air-lines of the other free peoples who had been allies in war and would still be allies in peace.

One thing was certain. The day of "back-yard" flying rights had gone and must give place to a policy of the "open sky" for those who had fought with us. This was the spirit of the Atlantic Charter.

"I foresee three types of route," Capt. Balfour continued. "There will be the 'greyhound' route of stratosphere lines, flying stages of probably never less than 1,000 miles and carrying urgent passengers, freight and mails. There will be the main trunk routes connecting the capitals and other important centres. And there will be the 'feeder' services spreading out from these capitals and centres to the outlying districts of each territory.

"Each route will need a different sort of equipment. Government money will be required for design and research. It is no good thinking we can catch up the years lost in warfare or satisfy the needs of an educated public without expenditure of great sums of money.

"I believe we must accept improvisation with war equipment for a two- to three-year interim period. The day fighting ends we should start to keep open our routes with military equipment, converting it as best we can to civil needs. Thus we should use redundant equipment, train commercial crews, develop our ground organisation, gain general experience, and build up a goodwill ready for when we can swing into use our proper civil aircraft.

"As we start to operate on the interim period, the Government of the day must take courage in both hands and tell our aircraft industry to build, say, three types of overseas aircraft, one of which ought to be a giant flying boat. The Government must gamble a great sum of money—but, after all, little compared with one week's cost of the war—in ordering perhaps 500, 800 or 1,000 of these aircraft, with guarantees that they will be operating within two years from the time the order is placed.

"It is the duty of every citizen in this country, and throughout the British Commonwealth, to concern himself with the future." Capt. Balfour concluded.

MR. CHURCHILL RETURNS BY AIR

German Efforts to "Get" Our Prime Minister Outwitted : Touch of Genious in His Daring Choice of Destination

MR. WINSTON CHURCHILL'S return from America in the Boeing flying boat, *Berwick*, last week-end caught the imagination, not only of his devoted countrymen, but of the entire democratic world. People reading of his long flight from Bermuda and safe landing at Plymouth chuckled with affectionate glee not unmixed with relief, and exclaimed, "Good Old Winston!"

TWO FIRST PILOTS. Mr. Winston Churchill chatting to Capt. Kelly Rogers, O.B.E., in the pilots' cockpit of *Berwick*. While the Prime Minister was at the controls, Kelly Rogers occupied the second pilot's seat.

And they chuckled still more when they read of how his return had thwarted the frantic Axis efforts to "get" him on his way back. All sorts of assertions as to his medium of travel were put out by the enemy radio and Press in an endeavour to provoke London or Washington into denials which, by a process of approximate elimination, might have given them a clue to the real truth. It was such a patent trick—and such an old one—that one is amazed even the Germans could have hoped it would work. What kind of a people do they think we are, indeed?

The Prime Minister's decision to fly to Plymouth, of all places, was a touch of sheer genius in this battle of wits. To choose what is one of the hottest spots on our coastal front was just like the man whose nimble brain is one of the main "munitions" in democracy's fight.

Another aspect of the Premier's flight, which has made instant appeal to the *civilised* world, is the story of how he sat in the pilot's seat and held the controls during the crossing to Bermuda from the Virginian coast. Pictures of him holding the wheel and with his cigar clenched characteristically in his teeth appeared in almost every newspaper, at least one of which made a point of suggesting that the cigar was not lighted. But there is no ban on smoking in these big flying boats, since all petrol is housed in the wings; and, in point of fact, Mr. Churchill was not deprived of his favourite weed—an additional source of irritation to our outwitted foes.

No more capable pilot than Capt. J. C. Kelly Rogers (who needs no introduction to the readers of *Flight*) could have been selected for the responsible duty entrusted to him, and the trip from Bermuda to Plymouth, a distance of 3,330 miles, was covered in 17 hours 55 minutes at an average speed of approximately 190 m.p.h. Incidentally, it was Capt. Kelly Rogers who made the first delivery flight from Baltimore with the first of the three Boeing 314 flying boats bought by the Government—the *Bristol*.

R.A.F. IN MIDDLE EAST

A SENIOR air staff officer from the Middle East, reviewing R.A.F. operations in that theatre of war during 1941, said yesterday that on the year's work the balance was "well on the credit side." He told how, except in the present advance in Libya, the R.A.F. had always had to face superior numbers, and he gave new facts about several campaigns.

The preliminary bombing for the last British offensive was very heavy, and the pounding of the enemy's lines of communication before and after the advance began played a vital part in its success, for there was ample evidence that, even with the time at their disposal to accumulate large stocks, the enemy's petrol supplies ran short. By the end of 1941 the enemy had lost in air action, by air attack, or captured, 673 aircraft. Our losses over the same period were 195 machines.

Air supremacy in the Western Desert after Italy's entry into the war was gained against vastly superior numbers, and was not gained cheaply. We lost 252 crews before the Army had a man wounded, but the efforts of the R.A.F. enabled General Wavell's army to reach Benghazi in less than two months without any opposition from the enemy's air force.

During the year the Empire air forces wiped out the Italian air force in Libya and finished it off in East Africa. The Italians were also beaten in Greece. The Iraqi air force, reinforced with Germans and Italians, was accounted for; then the Vichy-German forces in Syria; and finally the German air force in North Africa was met and beaten.

It was estimated that during the fighting in Greece the Germans alone threw into their attack from Bulgaria 1,000 aircraft of all types, of which about one-third were fighters and nearly one-fifth dive-bombers. Against these we had about 150 aircraft of various types, which included only one squadron of modern fighters.

We lost many fine pilots and crews—"very gallant gentlemen"—but the spirit of inspired self-sacrifice was universal during these last grim days. During the evacuation from Greece our pilots flew machines which were riddled with bullets and in need of repair, and went on fighting as long as their aircraft could fly.

During the Iraqi revolt the defence of the flying training school at Habbaniya was "an epic in itself." We had only 65 aircraft which could be used for operations, including obsolete and training machines, and only 35 pilots were available, of whom the majority were instructors or half-trained pupils with little or no operational experience. Improvised bomb racks were fitted on the training machines, and the flying training school went forth to fight. During five days 647 sorties were made, over 3,000 bombs were dropped on the enemy, and 16,000 rounds of ammunition fired.

The staff officer praised the work of the pilots and crews in Eritrea and Abyssinia, who fought with "a varied and motley collection" of aircraft, and he paid tribute to the fine work of the R.A.F. in Malta.

HERE AND THERE

Overseas Lunch

WHEN Capt. Harold Balfour, Under-Secretary of State for Air, spoke at the weekly lunch of the Overseas League, the Dominions were well represented among the guests.

The chair was taken by the Hon. S. M. Lanigan O'Keeffe, High Commissioner for Southern Rhodesia, while near him were sitting Air Marshal Williams, Royal Australian Air Force, and Wing Cdr. Newall, Royal New Zealand Air Force.

Air Comdre. Hull, R.A.F., was also present.

Bomber Diving Record

A DIVING record for bombers is claimed in *American Aviation* for Ellis D. Shannon, the Glenn Martin test pilot, who is reported to have dived a Baltimore at 560 m.p.h.

This, incidentally, was not a T.V. effort, but was carried out at an angle of 65 degrees "at nearly full throttle." The report says that a maximum A.S.I. reading of 400 m.p.h. was recorded at 17,000ft., the dive having been started at more than 20,000ft.

At such altitudes, of course, the A.S.I. would read low; in this instance, apparently, it was reading 40 per cent. below the true speed.

Dangerous Dust

ALTHOUGH the risk of explosion with magnesium dust in the workshop is no greater than with the dust of most other metals, certain precautions are necessary, and in their absence explosions are likely to occur.

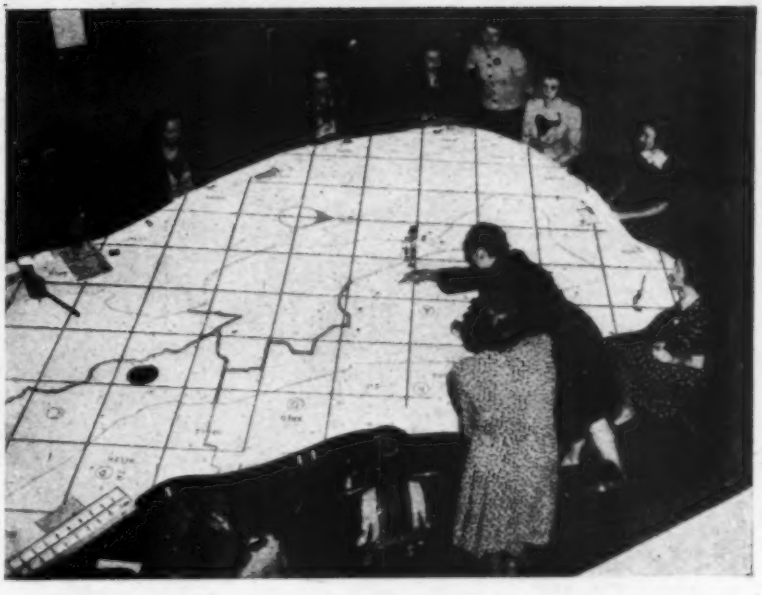
For the benefit of all machinists of magnesium alloys, F. A. Hughes and Co., Ltd., whose emergency address is Swinton, near Manchester, have issued a little booklet describing what, in their own experience, has proved to be the best of several methods of dealing with this safety-first problem. The booklet is entitled "Magnesium Dust Extraction," and copies can be obtained from them free on application.

Never too Old to Fly

PRECISE news of enemy activity in the Dutch East Indies being none too easy to come by, it is never possible to know at any given moment to just what extent the war in those far-off parts may have affected civil flying in any particular locality.

But as recently as a fortnight ago, at any rate, news reached us that Dr. M. A. G. Harthoorn, the 56-year-old president of the N.E.I. High Court, had made his first solo flight as a member of the Batavia Flying Club, and was zealously training for his brevet.

To this air-minded magistrate we would say, "Happy Landings, Your Worship!"



NERVE CENTRE: This is the plotting room of America's "Fourth Interceptor Command" in San Francisco, where all information from observers throughout the area, concerning aircraft in the air, is co-ordinated. Unlike our Fighter Command, its function is confined entirely to defensive "ops."

Home on Leave

AS these are days of all sorts of records, probably the record for distance travelled when going home on leave can be claimed by P/O. Robert Mannix, of the Eagle Squadron, R.A.F., who, in an issue of the *Douglas Airview* just to hand, was welcomed home in Santa Monica, California "—direct from England on the first official furlough granted by the force."

P/O. Mannix's brother, Paul, happens to be a Douglas engineer at the Santa Monica plant, and the 25-year-old Eagle pilot spent part of his leave in conference with Douglas executives discussing several practical ideas he had gathered in actual combat with Hurricane, Spitfire and DB-7 aircraft—a bit of a Hurribusman's holiday, in fact!

For Tough Guys Only

A GOOD idea of the conditions likely to be encountered by U.S. Navy pilots when visiting places "South of the border" is conveyed in the *Notice to Aviators* issued by the Hydrographic Office at Washington.

A recent issue, for example, describes the landing field at Nicoya, Costa Rica, as consisting of a rectangular strip NE/SW, 1,950ft. by 150 ft., with prevailing winds east and south-east. It adds: "Strong cross winds up to 50 m.p.h. from the east during the dry season. During the wet season the field becomes muddy and sticky."

Hardly the place for one's first solo!

Then there is San Felix airport, Venezuela, of which it says, "Facilities—None." San Felix, sans facilities, in fact.

Now They Spell It "Spead"

FROM the friendly pages of *Consolidator*, the house journal of the Consolidated Aircraft Corporation of America, we cull the story of how some R.A.F. experts, wishing to assess the drag set up by protruding rivet heads, decided to compare the top speeds of identical aircraft (a) with flush riveted skin and (b) with protruding rivets.

To do this they decided to take a flush riveted aircraft (type not stated) and, after checking its maximum speed, convert it into the other kind *by gumming half-section dried peas over the thousands of flush rivet heads on the metal skin!*

What a job!—even assuming that special dispensation from Lord Woolton provided bushels of already bisected vegetables of uniform size.

If genius is an infinite capacity for taking pains, then here it is!!

New Dunlop Comptroller

MR. F. R. M. DE PAULA, O.B.E., F.C.A., has resigned his appointment as Controller of Finance of the Dunlop Rubber Company in order to become Joint-Managing Director of Messrs. Harding, Tilton and Hartley, Ltd., of Taunton, Somerset. Mr. de Paula's connection with Dunlops will not be entirely broken, as he will continue to assist them in an advisory capacity.

Mr. J. H. Lord, C.A., will assume the duties previously carried out by Mr. de Paula and will have the title of "Comptroller."

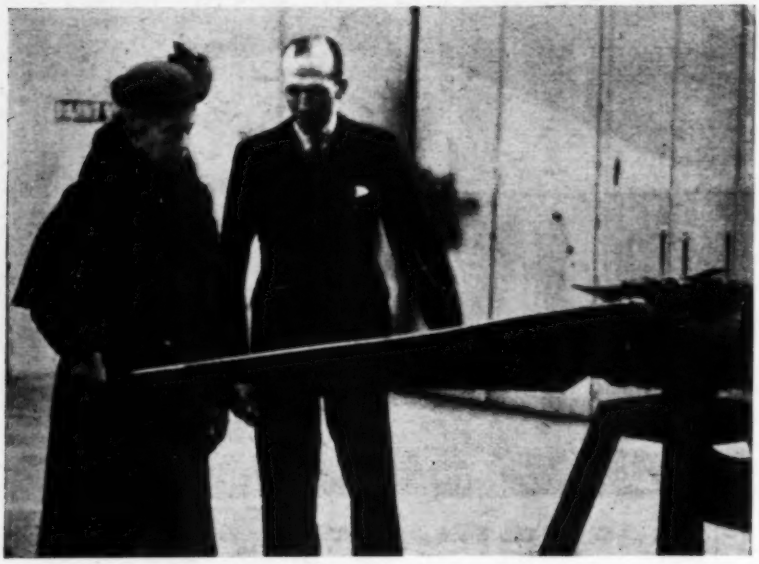
Fast Fighters

NEWS of a very fine performance by an American "pursuit" aircraft reaches us from Farmingdale, N.Y., though no mention is made of the speed and direction of the wind prevailing at the time—if any.

Capt. James Philpott, of the U.S. Army Air Corps, is reported to have flown a Republic P-43, Lancer, from Lowry Field, Denver, Colorado, to New York City at an *average* speed of 381 m.p.h.

From Denver to New York, as the plane flies, is 1,800 miles, and as the flight was made with full service equip-

HERE AND THERE



ROYALTY AT ROTOLS: Queen Mary recently visited a Rotol airscrew repair factory, and here she is seen with Mr. R. Stammers inspecting a typical example of their vital work—an airscrew, damaged in combat, which has been restored to new condition and is ready to go back into active service.

ment, this combination of range and speed is distinctly good. The Lancer, powered by a supercharged 1,200 h.p. Pratt and Whitney engine, is a high-altitude aircraft, but no mention is made in the report of the actual height at which Capt. Philpott made the journey. To have covered the distance, as he did, in 4hr. 43min., he must have used a big proportion of the available power, which is a testimony to the stamina of the air-cooled radial engine.

Breaking Into Prison

BELIEVE it or not, Sergeant-Observer R. Bruce Petersen, of Toronto, baling out over England one dark night found himself, on contact with land, a prisoner of war.

Petersen's descent was apparently ill-timed, for the 108-pound navigator wafted slowly to earth, to descent within the barbed wire confines of a prisoner-of-war camp.

London "Bobby's" New Beat

TWENTY-TWO-YEAR-OLD Leonard W. Thorne, G.M., ex-member of the Metropolitan Police, is now a cadet training to be an R.A.F. pilot at the South East Air Corps Centre, U.S.A.

Leonard Thorne won the George Medal for gallantry during a London air raid, when he was on duty in Tottenham Court Road, and rescued a number of people who were trapped in demolished, burning buildings. He saved twenty lives that night.

And Mother Joined Too!

A MOTHER whose husband is a chief petty officer in the Royal Navy, whose son is in the Merchant Navy, and whose daughter is in the W.A.A.F., is now herself in the W.A.A.F. She is serving as a cook in the airmen's and airwomen's mess at a headquarters of the R.A.F. Army Co-operation Command.

Before she entered the Service, she had lived in a heavily bombed area and her home, and a business which she had bought and carried on there, was wrecked in one of the raids. Nights spent in an air-raid shelter were tedious. She wanted to do some active war work. So she followed the example of her daughter and joined up.

Death of Mr. W. A. Oubridge

IT is with regret that *Flight* has to announce the death, on January 2nd, of Mr. W. A. Oubridge, chairman and director of the British Piston Ring Co., Ltd., of Coventry, which he himself founded.

Mr. Oubridge, who had been ill for some considerable time, was buried at Coventry.

Pets in the R.A.F.

NOBODY loves a pet more than an airman, and although Orders state that "dogs and other live stock" may not be kept on an airdrome "except by the consent of the commanding officer," there are usually plenty of pets about. Which indicates that C.O.s have a soft spot for animals, too.

The Group Captain commanding one bomber station, for example, has a tiny terrier which always accompanies him, and stands quietly beside his master on the edge of the flying field at every take-off.

A squadron leader at a northern station keeps a budgerigar in his room. Sometimes it is invited as a guest in the mess, where it sips beer from the rim of a tankard. It is a fine talker, but its language is not suitable for the best company—as the padre has sometimes remarked.

DESERT RESCUE: Two Hurricane pilots of the S.A.A.F. snapped after the one in the helmet had landed in enemy territory and picked up his wounded comrade who had been forced to bale out. The rescuer had to disperse approaching enemy with his gunfire before he could land.

Correspondence

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

TURBO-SUPERCHARGING

Effect of Exhaust Back Pressure

YOUR interesting article, "Turbo-Supercharging," in your issue of January 1st, 1942, gives me the opportunity to deal with views expressed there by the writer on this matter.

We read there: "It is not providing something for nothing, but is doing a certain difficult job in an efficient manner. In fact, it represents a considerable mechanical advance."

Yes, in general it is true, yet certain disadvantages of the applied system are worthy of mention. There is a difference between free exhaust and that in which the exhaust gases have certain work to do before they leave the engine and discharge into the surrounding atmosphere.

In the latter case the pressure of exhaust gases at the inlet into the nozzle ring of a turbine will be higher than that of free exhaust due to the resistance encountered. The braking effect on the gases creates conditions in which more heat is given up to the walls of the exhaust manifolds, and thus increased pressure seems to be inevitable inside them.

This increase of pressure, in comparison to the free exhaust, must have its influence on efficiency due to the somewhat obstructed exhaust, and the actual output of power will be less than the theoretical one.

The same has been observed by running an engine with manifolds and long exhaust pipes, and without these items, when testing; in the latter case a certain definite increase of power has been noticed.

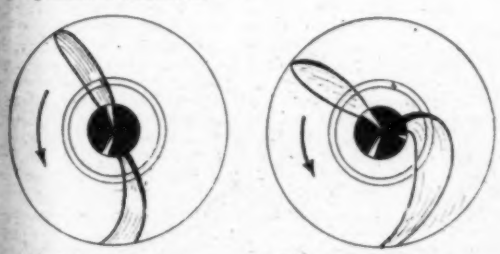
But in spite of these the advantages of the application of a turbo-supercharger to aircraft engines are obviously great, and the whole work is a nice technical achievement.

W. JAWORSKI.

CAMERA CURIOSITY

Shutter Acceleration

FURTHER to letters by recent contributors on the points raised in "Camera Curiosity," I should like to introduce a further point and that is the question of *camera shutter movement*. I must confess that I am far from an expert on photography, but examination of the camera that I normally use shows that the film is exposed from bottom to top, the shutter opening from bottom to top and closing top to bottom. This may vary in different cameras, but the principle of the following argument is unaltered.



(a) SLOW REVOLUTION (b) FASTER REVOLUTION

Taking the simplest case, i.e., a head-on view, in which the airscrew is revolving in an anti-clockwise direction, we will assume that snapshots are taken at two different engine speeds. The results will appear as (a) and (b). The shutter takes time to open and so apparently the bottom of the plate is exposed for a slightly longer period than the top, sufficient to allow the bottom blade to move through nearly 120 deg. or one-third of a rev. in case (b).

Thus the lower blade appears distorted and more curved than the upper in this particular case. Where the reverse is true (i.e., when the upper blade is the more curved), my theory would indicate that the film has been exposed from top to bottom. Thus the "curved distortion" of revolving blades appears to be a question of shutter movement. Perhaps some photographer would care to comment on this?

PROP POSN.	TWO BLADED			THREE BLADED			PROP POSN.
	HEAD ON	3-QUARTER	SIDE	HEAD ON	3-QUARTER	SIDE	
|	2	9	8	5	40	6	Y
X	2	11	3	3	21	3	⊀
—	2	1	2	2	43	11	⊤

The main question raised by "puzzled schoolboy," namely the apparent "standardised" propeller position in photography, is largely a question of attitude. As C. Rupert Moore showed, the *probability* that the airscrew will appear vertical is greater than the probability that it will appear horizontal, but it is by no means a hard and fast rule.

The table is compiled from a study of photographs in about 50 back numbers of *Flight*. The number of times that the airscrew appeared in positions indicated by the small diagrams in the two extreme columns is shown for three different views for both two and three-bladed airscrews.

R. H. WARRING.

AIRSCREW TERMINOLOGY

Need for Standard Expressions

YOUR recent articles on propellers have prompted me to write this letter, since there appears to be considerable confusion in recent propeller terminology, not only in Great Britain but also in America.

No two people will agree as to whether propellers on the same shaft in the tandem relationship should be called dual rotation, counter-rotation or contra-propellers. There is also some discussion as to what fixed vanes behind a propeller, to reduce rotation in the slipstream, should be called, but the majority apparently agree on contra-vanes. In addition, there is the question as to what to call propellers on a two-engine aircraft where the propellers, as viewed from the slipstream, rotate in clockwise and counter-clockwise directions. The writer prefers the term "oppositely rotating propellers," but to be strictly correct it would be best to refer to these propellers as left- and right-hand propellers, viewed from the slipstream.

As to the controversy regarding the tandem propellers on the same shaft, there is a definite leaning toward the use of the term "dual rotation" around here, the total number of blades being prefixed before the designation. That is, two four-blade propellers in tandem would be called an eight-blade dual-rotation unit.

I think you will agree that there is definite need for standardisation in propeller terminology, leaving out, of course, the age-old question whether it is "airscrew" or "propeller," in order to eliminate existing confusion. Perhaps your readers also have some definite thoughts in this connection, which would prove interesting.

May I take this opportunity to state that I have read *Flight* over the past several years and have always found it very interesting and informative.

RICHARD C. MOLLOY
(Aeronautical Engineer, Research Division).
United Aircraft Corp.,
East Hartford, Connecticut.

BARREL ENGINES

Rotary Valves Recommended

THE very interesting article on wobbler-plate engines does not appear to have aroused much comment from your readers—perhaps it was too convincing to argue about.

Your contributor seems to have overlooked the most obvious

CORRESPONDENCE

of all valve gears to incorporate in his suggested design—the Aspin rotary valve. Apart from its superior performance, its sheer simplicity must make it a success from the production point of view.

Its thermal efficiency is apparently so good that air-cooled cylinder heads made from magnesium alloy may be used (see advertisement in *Flight*, December 18th, 1941, facing editorial page). This surely calls for some investigation into the possibility of further reducing weight of the barrel motors.

With the use of a turbo-blower for supercharging the air, and petrol-injection apparatus, this motor should go a long way to producing the ideal suggested. Especially is this so when you consider that the plugs are masked from the heat during most of the expansion stroke and that the valves actually help towards the flywheel effect of the engine—high revolutions ceasing to be a danger as far as valve gear goes.

I have no connection with the Aspin firm, except a natural interest in a motor that proves reliable when turning out 100 b.h.p./litre without supercharging, while running on normal motor car fuel plus 25 per cent. paraffin.

It might not be practical, but might I suggest that the arms of the wobbler (or spider, as I like to call it) be purely circular, and pass through a spherical bush retained in the centre of the piston. The bush should be the same shape as the sleeve crank ball used on the Bristol sleeve-valve engines. Provision would have to be made to prevent the piston from rotating too far, of course.

"A JIG AND TOOL DRAUGHTSMAN."

AIRSCREW BLADE MATERIALS

Further Thought on Wood v. Metal

I WAS very pleased to see in your issues of November 20th, December 4th and December 11th, 1941, the article by Mr. Chown on the case for wood, the article on repairing wooden blades, and Mr. Brady's letter about hollow steel blades.

Mr. Chown suggests that the efficiency advantage of thin metal blades has been overrated, but I think that the best evidence here is the fact that I know of no single case in which wood and metal airscrews have been tried on the same aircraft where the wooden one has given a greater top speed. Many well-authenticated figures exist in the opposite direction. He also states that some dural blades have thinner tip sections than present Jablo methods permit. I think it would be truer to say that almost all present dural blades have these thinner sections, and it is undoubtedly true that the limit of dural has not been reached any more than it has on wood. In this connection, the curve shown in Mr. Brady's letter of thickness ratio for a dural blade seems, as far as one can read the very wide scale, to give higher thickness/chord ratios than we would now consider necessary or desirable. In the case of wood, there is the further point that even though, from considerations of stresses during operation, the thickness/chord ratio may be reduced still further, the flexibility and comparatively low strength of the wood must surely make the blade very much more liable to handling damage.

Mr. Chown's suggestion that latest American blades tend to have wider tips is true in some cases, but this greater width is not, as he suggests, associated with greater, but with lower thickness/chord ratio. The main reason for these wide tips is undoubtedly the necessity of increasing blade area without increasing diameter on machines which have been fitted with engines of greater power than those for which they were originally designed.

The thick tips used on wooden blades are, as Mr. Chown suggests, normally associated with smaller diameters than those used on metal airscrews in order to reduce the tip speed in an effort to avoid excessive compressibility losses. These thick sections do undoubtedly give, in most cases, higher thrusts at take-off than would be obtained on an otherwise identical airscrew having thin blades, but the reduction in diameter causes the loss of at least a great part of this take-off advantage.

On the subject of blade root shape, Mr. Chown maintains that the wooden blade is superior. He is probably correct in saying that a wooden blade can be made with thickness/chord ratios at the spinner line as good as, or better than, dural. This good thickness ratio, however, must, in the case of wood, be obtained by using a very wide chord. From performance considerations, this is less efficient than using a narrow chord, as the root sections supply comparatively little thrust, and the best that can be done is to reduce their drag to a minimum by using not only the best possible section, but also the smallest possible chord. When a dural blade is made with good root sections and a narrow chord, the weight penalty which Mr. Chown suggests has to be paid is extremely small, usually only about 2lb. per blade. If, however, the flare is to be considered, not as a means of improving performance, but as a means of providing additional cooling for radial engines, then the wide chord of the wooden blade is desirable, and for these conditions it is true that a flared dural blade would have to pay quite a heavy penalty in weight. It is for such cases as this that the cuff may be required.

On the score of reliability, Mr. Chown has stated that Jablo blades can claim complete freedom from failure. I am very glad to be able to congratulate him on this excellent record. However, I do not think it can be denied that, as pointed out in my original article, the life of a dural blade, especially under severe operating conditions, such as sand, grit, water, extreme heat or extreme cold, is superior to that of the wooden blade.

Both Mr. Chown and Mr. Brady have queried the figure of 80 per cent. for the proportion of damaged blades which are returned to Service. Mr. Brady says that my statement implied that 80 per cent. of all damaged blades are repairable, but I would like to point out that my original article specifically stated that this 80 per cent. was the proportion of blades from all airscrews which are returned to de Havillands for repair. Actually, the proportion of airscrews which are never returned, apart, of course, from those on aircraft shot down over the sea or in enemy territory, is extremely small. Even in the worst cases, airscrews are returned for the reclamation of undamaged parts. The figure of 80 per cent. was arrived at as a result of a study of all the repairs which we were doing about a year ago during the Battle of Britain.

Mr. Chown suggests also that with wooden blades the damage to the hub and the engine will be less than with dural blades. I agree that this is a point which certainly needs to be considered, and in fact the airframe should also come into the argument. However, I think that his statement is extremely controversial. For one thing, against his argument that the breaking of the wooden blades may save further damage to the engine, there is the consideration that a bent metal blade acts as a very effective skid and may prevent damage to the airframe.

I was extremely interested in Mr. Brady's statement that hollow steel blades are now being repaired, and I would like to congratulate him on having found some solution to an undoubtedly difficult problem. Without knowing details of the process it is, of course, quite impossible to compare the relative ease and cost of repairs to hollow steel blades with those to blades of other materials.

On the subject of weight, Mr. Chown makes the perfectly valid point that the weight of a wooden airscrew is often unnecessarily high because the blades are fitted to a hub which has been made strong enough to take metal blades. It may even be true that this is responsible for those cases in which the dural-bladed airscrew comes out lighter than the wooden one. In some investigations at de Havillands, however, it seemed that this did not affect the argument to any very great extent. I would, however, assure Mr. Chown that we know of a number of cases in which an actual dural airscrew is slightly lighter than a corresponding wooden one. I have sent actual comparative figures for Mr. Chown's personal information.

On the subject of availability of materials, I am grateful for Mr. Chown's tribute to the fact that we would be ready with a hub specially designed for wooden blades if it became essential for us to use this material, and can assure him that this would be the case. The point I was trying to make, however, was that at present supplies of both materials are available, and that under these circumstances I consider the dural blade to be superior. I quite agree that under present circumstances the country needs every blade that can be made, and that as wood and facilities for manufacturing it into blades do exist, undoubtedly wooden blades should be made and will give satisfactory service in many applications.

On the subject of availability of labour, I think we can only say that on metal blades, as well as wooden ones, a very high proportion of unskilled labour can be, and is, used. I notice that, in his article, Mr. Chown made no mention of cost of either new or repaired blades. I think there is good evidence that in production quantities the dural blade is considerably cheaper than the wooden one.

(For the De Havilland Aircraft Co., Ltd.).
K. B. GILLMORE,
Chief Designer (Airscrews).
Engineering Department.

Service Aviation

Royal Air Force and Fleet Air Arm News and Announcements

R.A.F. Regiment

Uniforms and Conditions of Service

The uniform of the Regiment will be the ordinary R.A.F. pattern blue tunic and trousers, which will be worn off duty for "walking out," and on ceremonial occasions. Working kit will, however, be khaki battledress, which is less conspicuous than blue and more suitable in every way for land fighting. When not actually at the defence posts, where the men will, of course, wear steel helmets, the personnel will wear their blue field service caps with their khaki battledress.

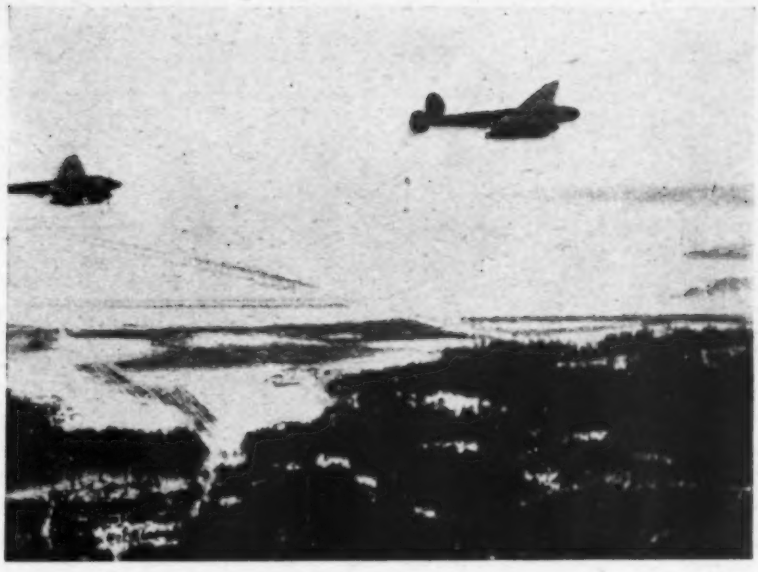
Army officers seconded for duty with the R.A.F. Regiment will continue to wear their own regimental uniform at all times, although such non-commissioned officers and men as go over from the Army will normally be transferred to the R.A.F. and wear its uniform. All ranks, whichever their parent service, will wear a distinguishing badge or emblem to indicate that they belong to the Regiment. The exact design of this badge has not yet been settled.

The conditions of service in the R.A.F. Regiment will be the same as those which apply to any other branch of the Royal Air Force, and the airmen will be mustered to a special trade and known as "gunners" to distinguish them from "air-gunners." They will not all be "gunners" in the Army sense of the term, but as the majority will have to handle some kind of gun or automatic weapon the title is appropriate.

The R.A.F. already has a large number of airmen who have been trained as machine-gunners, and for other forms of ground defence employment, and these men, together with those transferred from the Army, will be used to form the Regiment. No special recruiting for the Regiment will be opened at present. If additional personnel should be required in due course, they will be selected from the ordinary intake into the R.A.F. on registering. A man will not be able to opt for service with the Regiment any more than he can opt for any other R.A.F. specialist trade, although he may opt for air employment or ground employment in the R.A.F.

Pay will be at ordinary R.A.F. rates, although arrangements will be made to ensure that officers, non-commissioned officers and men seconded from the Army do not suffer any financial loss thereby.

The units of the Regiment, which will be allotted as the "hard cores" of aerodrome garrisons, and which in an emergency will be strongly supported by the other R.A.F. personnel on the station, will be armed and equipped so as to give them a high degree of fire power and local mobility, and will be trained to take the offensive on every possible occasion. Details of the weapons to be provided cannot, of course, be given.



Russian B.B.22 twin-engined bombers operating on the Moscow front. The B.B.22 is a dive-bomber with liquid-cooled engines.

Awards

Fleet Air Arm in Battle of Crete

The following awards are announced for outstanding gallantry, fortitude and resolution during the Battle of Crete:—

DISTINGUISHED SERVICE CROSS

Lt. (A). L. K. KEITH, R.N., H.M.S. Decoy.
Temp. Lt. (A). A. B. RAMSAY, R.N.V.R., H.M.S. Decoy.

Daylight Raid on Brest, December 18.

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy:—

One day in December, 1941, a strong force of bomber aircraft carried out a determined attack on the German warships, *Gneisenau* and *Scharnhorst* at Brest. The operation was carried out in the face of extremely heavy and accurate anti-aircraft fire and determined attacks by enemy fighters. Nevertheless, the aircrews engaged

The first picture of the R.A.F. Regiment in operation shows how not to do it. The police corporal would be somewhat unlucky if the R.A.F.R. gunner had to open fire with his tommy gun.

SERVICE

pressed home their attacks to the utmost and succeeded in scoring hits on their objectives. Several enemy aircraft were shot down. The success of the operation, which demanded the highest degree of skill and courage, reflects the greatest credit on the efforts of the following officers and airmen who participated in various capacities as leaders and members of aircraft crews:—

DISTINGUISHED SERVICE ORDER

Wing Cdr. B. V. ROBINSON, D.F.C., No. 35 Squadron.

DISTINGUISHED FLYING CROSS

Wing Cdr. H. R. GRAHAM, D.S.O., No. 7 Squadron.
Wing Cdr. P. B. B. OGILVIE, D.S.O., No. 15 Squadron.
Act. Wing Cdr. D. O. YOUNG, A.F.C., R.A.F.O., No. 76 Squadron.
Act. Sqn. Ldr. F. D. WEBSTER, No. 10 Squadron.
F/O. P. J. S. BOGGIS, No. 15 Squadron.
F/O. C. A. VERNIEUX, R.A.F.O., No. 15 Squadron.
W/O. N. L. TAYLER, No. 7 Squadron.

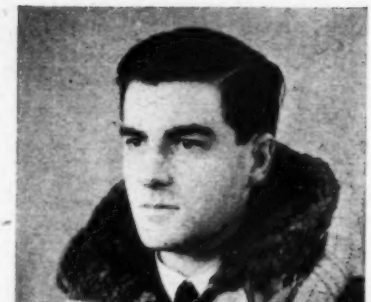
DISTINGUISHED FLYING MEDAL

Flt. Sgt. R. H. HARDY, No. 15 Squadron.
Sgt. E. E. DE JOUX, No. 7 Squadron.

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy:—

DISTINGUISHED SERVICE ORDER.

Act. Flt. Lt. L. B. ERCOLANI, R.A.F.V.R., No. 214 Squadron.—One night in November, 1941, this officer was the captain of an aircraft detailed to attack Berlin. The target area was completely obscured by heavy cloud and Flt. Lt. Ercolani decided to retain his load of incendiary bombs in order to avoid diverting following aircraft by starting fires in the wrong places. High explosive bombs, however, were released over searchlight and anti-aircraft defences. On the return journey the aircraft was hit in the bomb racks by enemy shell fire. The floor was torn up and flames burst through the aperture. Following an unsuccessful attempt to jettison containers which were burning, the fire spread over the whole floor, filling the aircraft with smoke and sparks. The fire eventually subsided, but was never completely extinguished, leaving the mid-part of the aircraft almost burned away. Both wings were holed and the fabric torn, while other damage was sustained which caused the aircraft to lose both height and speed. Despite these appalling conditions, Flt. Lt. Ercolani attempted to fly the aircraft back to this country, but shortly after crossing the enemy coast, at 1,000 feet, the engines failed through lack of fuel and the aircraft came down in the sea. The pilot had then been flying a burning aircraft for some three hours and for most of the time the aircraft had presented a fiery target for the enemy 's guns. Flt. Lt. Ercolani received injuries when the aircraft hit the water and he went down with it, but it surfaced again and he was able to get in the dinghy with the remainder of the crew. Despite his injuries, Flt. Lt. Ercolani took charge and, displaying great leadership, inspired



Act. Flt. Lt. L. B. Ercolani, who has been awarded the D.S.O. The official citation appears on this page.

his comrades until the dinghy finally went ashore on the Isle of Wight some 57 hours later. Throughout, this officer displayed courage, initiative and devotion to duty worthy of the highest praise. Flt. Lt. Ercolani has completed 26 operational missions.

DISTINGUISHED FLYING CROSS.

Act. Sqn. Ldr. W. R. WILLIAMS, with effect from July 16, 1941.
Flt. Lt. A. D. GOSMAN, with effect from Aug. 11, 1941.
F/O. R. MCD. DURHAM, with effect from Aug. 11, 1941.
P/O. E. A. MASTERS, R.A.F.V.R., with effect from July 24, 1941.

Act. Wing Cdr. J. D. ROLLINSON, R.A.F.O., No. 38 Squadron.—This officer has carried out 30 operational sorties from Malta. First as a flight commander and later as the commanding officer, Wing Cdr. Rollinson has performed sterling work. Wing Cdr. Rollinson himself has contributed materially to the outstanding successes achieved by his squadron. Throughout, he has shown cheerfulness and courage and he has been undeterred by difficulties.

Major O. W. B. VAN GINKEL, S.A.A.F., No. 12 Squadron.—This officer has participated in operations in East Africa and the Western Desert. He has completed many bombing raids. As flight commander, Major Van Ginkel has displayed remarkable leadership and devotion to duty. His services, particularly in the Western Desert, have proved his ability and courage.

Major J. A. RADEMAN, S.A.A.F., No. 20 Squadron.—This officer has completed many bombing raids, both in East Africa and the Western Desert. As a flight commander he has rendered invaluable service, and has always displayed high courage and devotion to duty.

Flt. Lt. E. CASSIDY, No. 249 Squadron.—This officer has been actively engaged in operational flying, both in England and in Malta, since the war began, and has destroyed two enemy bombers at night. In a recent engagement, on a dark night, Flt. Lt. Cassidy displayed great tenacity when severely damaging two enemy aircraft. It is considered likely that one of them probably failed to reach its base. This officer has shown considerable dash and initiative. He has set a splendid example.

Flt. Lt. D. F. WYKEHAM-MARTIN, R.A.F.V.R.—This officer's vigilance and alertness have enabled him to sight and attack enemy submarines on four occasions. All these attacks produced promising results; after one attack which Flt. Lt. Wykeham-Martin carried out large air bubbles and oil were observed. This officer has served with great distinction, and he has shown great skill when flying in adverse weather conditions.

Act. Flt. Lt. D. L. BISGOOD.—This officer has carried out a large number of meteorological flights, often involving flying in extremely unfavourable weather conditions. One day, while carrying out one of these missions, he observed three enemy bombers. Flt. Lt. Bisgood decided to attack and, skilfully using cloud cover, effected a surprise attack on one of the Junkers. Following a long burst from Flt. Lt. Bisgood's guns, the enemy bomber caught fire and plunged into the sea.

Previously, Flt. Lt. Bisgood had destroyed three hostile aircraft whilst flying with a Hurricane Squadron. He has at all times shown high devotion to duty and by his skill and determination he has obtained the required meteorological data on many occasions when otherwise it would not have been obtained.

Act. Flt. Lt. W. E. G. HEANLY, R.A.F.V.R., No. 38 Squadron.—This officer's efficiency, enthusiasm and untiring energy have been reflected in the admirable work of the Squadron. On numerous raids over Tripoli when low flying attacks have been made on road transports and aerodromes, Flt. Lt. Heanly has inflicted great damage to enemy property.

F/O. J. M. V. CARPENTER, No. 126 Squadron.—This officer has been engaged on operational flying over a long period. He fought in the Battle of Britain and destroyed four enemy aircraft, besides damaging many others. He has participated in numerous operations since he has been at Malta and has destroyed two Italian aircraft. In a low flying attack over Augusta, the elevator and rudder controls of F/O. Carpenter's aircraft were shot away. In spite of this, he flew the aircraft over 129 miles of sea to his base, and landed safely.

AVIATION

The initial training of W.A.A.F. personnel in the art of handling barrage balloons is carried out with a model and rings in the table to represent anchor points.

This officer has consistently shown great courage and fighting spirit and has set a magnificent example.

Act. Sqn. Ldr. A. D. McN. BOYD, R.A.F.V.R., and Act. Flt. Lt. A. J. GLEGG, R.A.F.V.R., both of No. 600 Squadron.

Sqn. Ldr. Boyd and Flt. Lt. Glegg have flown together in numerous night operational sorties. Sqn. Ldr. Boyd is a skilful and determined pilot, and he has destroyed three enemy aircraft. Flt. Lt. Glegg, by his great skill as observer, has largely assisted his pilot in the successes achieved. Both these officers have shown exceptional keenness and devotion to duty.

Act. Sqn. Ldr. R. J. K. HOGG, No. 115 Squadron.—One night in December, 1941, this officer was detailed to attack a target at Brest. Despite intense and accurate anti-aircraft fire and searchlight opposition, Sqn. Ldr. Hogg made several determined attacks even after his aircraft had been hit several times by shell-fire. During the attack he courageously attempted to draw the enemy fire from another aircraft which was caught in a heavy barrage by making close circuits of the fire zone. This officer has completed 55 operational sorties, including 16 in Libya and Greece. He has at all times shown great courage and resource.

Flt. Lt. A. J. H. FINCH, R.A.F.O., and P/O. A. H. ALDRIDGE, R.A.F.V.R., both of No. 217 Squadron.

One day in December, 1941, Flt. Lt. Finch and P/O. Aldridge participated in an attack on an enemy convoy of eight ships, escorted by two armed vessels, off the Dutch coast. Skilfully approaching the largest ship, Flt. Lt. Finch flew into the attack at an extremely low level. Evading the ship's defensive fire, he machine-gunned the bridge and, flying across the vessel at mast height, released a stick of four bombs; it is estimated that three direct hits were obtained.

P/O. Aldridge followed his leader's example with great determination, and, as the target vessel was obscured amidships by the smoke caused by the explosions of his leader's bombs, he skilfully aimed his bombs nearer the bows of the ship and obtained several hits. In accomplishing this, P/O. Aldridge flew so low that the wing tip of his aircraft was severed by the bracing wires of a mast. Throughout both these officers showed great courage, combined with rare skill and judgment.

P/O. D. PASSMORE, R.A.F.V.R., No. 42 Squadron.—In November, 1941, this officer was the leader of a formation of aircraft detailed to attack shipping off the Danish coast. Owing to adverse weather conditions, the aircraft was unable to keep formation, but F/O. Passmore succeeded in locating the target, a supply ship escorted by five destroyers, and, in spite of heavy opposition, carried out a determined low-level bombing attack.

A few days later he attacked a medium-sized supply vessel in convoy off the Norwegian coast and, despite heavy anti-aircraft fire, which damaged his aircraft, he succeeded in scoring a direct hit on the vessel with one of his bombs.

F/O. E. F. EDSALL, R.A.F.V.R., No. 602 Squadron.—This officer has participated in operational flying over a long period. He fought in the Battle of Britain, during which he destroyed at least four enemy aircraft before he was severely wounded in combat. Since he returned to operational flying, F/O. Edsall has carried out numerous sorties over Northern France. He is a courageous and skilful fighter pilot who, in spite of his injuries, has continued to set a splendid example.

Act. Sqn. Ldr. A. M. MURPHY, No. 138 Squadron.—This officer carried out a hazardous mission with complete success despite navigational difficulties and adverse weather conditions. On a previous occasion, when returning from an operational mission, Sqn. Ldr. Murphy passed over an enemy convoy at the low altitude of 100 feet. He noted its position, counted the ships and observed their course, and then reported the information to base. The information proved of great value. This officer has invariably displayed great courage and initiative.

Act. Flt. Lt. A. L. WINSKILL, R.A.F.V.R., No. 41 Squadron.—This officer has carried out over 250 hours operational flying and has destroyed at least three enemy aircraft. One day in August, 1941, he attacked two Messerschmitt 109's which attempted to intercept our bombers. He destroyed one of the enemy fighters, and his action certainly saved the bombers from serious attack.

F/O. W. W. CAVE, R.A.F.V.R., No. 502 Squadron.—This officer was captain of an aircraft engaged on an anti-submarine patrol. He observed, some three miles on his starboard bow, an outward bound U boat on the surface of the sea. F/O. Cave skilfully manœuvred to attack and released his complete load of explosives in a stick just in front and alongside the approaching U boat. The vessel was completely engulfed in the ensuing explosions, but remained long enough on the surface to allow for six front and rear machine-gun attacks to be directed at the conning tower. During the second of these attacks an occupant of the enemy submarine tried to reach the gun near the conning tower, but was driven to take refuge. Finally, the U boat submerged and a huge gush of oil rose to the surface and spread over an area 300 yards in diameter. The submarine was again seen for about 30 seconds, but then disappeared amidst oil. In spite of a temporary breakdown of inter-communication, F/O. Cave had drilled his crew to such perfection that he was able to inflict the most effective damage on the enemy. The attack was carried out with great skill by this officer, whose leadership and devotion to duty were of the highest order.

P/O. R. J. ROBINSON, R.A.F.V.R., No. 49 Squadron.—In December, 1941, this officer was the pilot of an aircraft which carried out a daring attack on an enemy airdrome in daylight. Just before the attack was made, the Perspex of the navigator's cockpit was shattered by a bird, but the attack was pressed home from a height of only 100 feet despite considerable opposition. Bombs were released on a hangar while a number of Messerschmitt 109's on the ground were machine-gunned and set on fire. P/O. Robinson's aircraft was hit by a cannon shell which riddled the navigator's cockpit and so seriously wounded the navigator that he died shortly afterwards. The aircraft sustained other damage, and the inter-communication and hydraulic systems were put out of action; the pilot's instrument panel was also damaged. P/O. Robinson set course for this country, and meanwhile the rear gunner tended the badly wounded navigator and beat out flames from his burning clothing. Overcoming many difficulties, P/O. Robinson flew back to an airdrome in this country, where he made a perfect landing with the undercarriage retracted. This officer has completed 24 operational missions over enemy country and has always shown high courage and great devotion to duty.

DISTINGUISHED FLYING MEDAL.

Flt. Sgt. J. S. CAMERON, with effect from Aug. 22, 1941.

Sgt. R. W. COX, No. 103 Sqn., with effect from Sept. 25, 1941.

Sgt. A. G. LOWE, R.A.F.V.R., No. 51 Sqn., with effect from Aug. 16, 1941.

Sgt. V. R. MARSH, with effect from July 26, 1941.

Flt. Sgt. R. V. ELLIS, No. 73 Squadron.—This airman has been actively engaged on operational flying since June, 1940. He participated in the intensive air operations in France and, just prior to the evacuation, he was responsible for arranging with another pilot for the passage to England of General de Gaulle. Flt. Sgt. Ellis subsequently fought in the Battle of Britain and destroyed four enemy aircraft.

Later, he participated in intensive operations over Sidi Barrani, Tobruk, Derna and Gazala. He fought during the period of the advance and later he took part in the defence of Tobruk at a difficult period. In one raid on Tobruk, Flt. Sgt. Ellis destroyed two Junkers 87; he then landed, and, taking off in another aircraft, he fought and shot down another Junkers 87.

Flt. Sgt. Ellis carried out a large number of hazardous sorties, machine-gunning mechanised transports and aerodromes to disorganise the enemy's forces during their advance from Benghazi. This airman has served with distinction throughout. Unaffected by these periods of continual warfare, he has retained both his skill and zest.

Sgt. J. W. BARNES, R.A.A.F., No. 37 Squadron.—This airman has participated in operational missions, which have included raids on targets in Cyrenaica, Greece, Sicily and Tripolitania. In September, 1941, Sgt. Barnes participated in four low flying attacks against objectives at Tripoli Harbour. In one of these engagements his aircraft was severely damaged by anti-aircraft fire, one engine and the instruments in the pilot's cockpit being put out of action, but he coolly and skilfully flew his aircraft safely back to base. Sgt. Barnes has set a worthy example.

Sgt. D. A. HORWOOD, No. 235 Squadron.—This airman was the wireless operator/air gunner of a Blenheim aircraft which became involved in combat with a Heinkel 111. Sgt. Horwood received a serious wound in the chest and, at the same time, the observer was so seriously wounded as to prevent him from carrying out further navigational duties. Following the engagement, the pilot set course for base, his only navigational assistance being the wireless operated by Sgt. Horwood. Although suffering intense pain, Sgt. Horwood displayed the greatest courage and fortitude and, for two hours until the aircraft was safely landed, continually operated his wireless set. Despite his condition, Sgt. Horwood's operating was of a high order throughout. His skill undoubtedly contributed materially to the safe return of his aircraft.

Sgt. L. J. C. WILDIG, No. 148 Squadron.—This airman has been engaged as an observer on operational flying since the war began. He participated in numerous raids, six of which were in daylight, over Germany and occupied territory. Since then, Sgt. Wildig has participated in many attacks against targets in Tripoli, Sicily and Southern Italy.

Amongst other successes achieved Sgt. Wildig scored a direct hit on the power house at Tripoli. He has also destroyed a number of enemy aircraft on the ground by his accurate bombing. His work has been consistently good and successive captains have placed the greatest faith in his ability both as navigator and bomb aimer. He has displayed courage and enthusiasm.

F/O P. J. S. Boggis, who was one of ten airmen to be decorated for their share in the daylight raid on Brest in December last.

A little rugger practice, in the shade of a Sunderland, by a Royal Australian Air Force squadron operating with Coastal Command.

SERVICE AVIATION

The hand-held camera used by the U.S. Navy air patrols operating from bases in Newfoundland. The Americans use a reducing lens type of sight, whereas we prefer an arrangement of crossed wires.

AIR Sgt. F. J. ERASMUS, S.A.A.F., No. 12 Squadron.—This airman has carried out many operational sorties in East Africa and the Western Desert. Entirely by his own initiative, he qualified from air gunner to observer, and as such he has proved to be one of the most reliable of observers. He has always shown courage and determination.

Sgt. R. FERGUSON, No. 7 Squadron.—This airman was the flight engineer of an aircraft which carried out a low-level attack on enemy shipping one day in December, 1941. By well-directed shooting he silenced a gun on an armed ship. The aircraft was hit by the enemy's cannon fire and sustained damage to the fuselage, the rear turret and tail chassis and the inter-communication equipment. Sgt. Ferguson cleared the rear turret and attempted to repair the inter-communication system, but, finding it impossible to effect even a temporary repair, he went forward and rendered first aid to the air observer, who had been wounded. Thereafter, Sgt. Ferguson rendered valuable service to his captain by acting as messenger. Throughout, this airman exhibited a fine example of discipline and teamwork. On several occasions he has displayed great skill and has thus contributed materially to the safe return of his aircraft.

Sgt. B. F. MOONEY and Sgt. I. J. PHILIP, both of No. 236 Squadron.

In December 1941, Sgts. Mooney and Philip were the pilot and wireless operator-observer respectively of an aircraft which carried out an important daylight reconnaissance. Defying heavy defences, Sgt. Mooney flew over the objective at a low altitude and most satisfactory results were obtained. Some days later these airmen volunteered to carry out a daylight reconnaissance of another objective and much valuable information was secured. Sgts. Mooney and Philip have executed many operational missions skilfully and efficiently.

THE KING has been graciously pleased to approve the following awards:—

GEORGE MEDAL.

L.A/C. H. MILLER.—In August, 1941, an aircraft returning from a sortie over France landed at a home base. Unknown to the pilot, three bombs which were thought to have been released remained in the aircraft and were detached on landing, one exploding and the others falling a short distance away. The aircraft soon became a blazing inferno, amid which bullets were exploding. The pilot and two of the crew managed to get out and tried to extricate the observer from the front part of the aircraft, but were unable to do so.

L.A/C. Miller, the driver of the fire tender which arrived shortly after the crash, then took over the rescue operations, cutting away the front part of the aircraft and succeeding in extricating the observer, regardless of the fact that bombs were lying nearby and others might have been in the aircraft. Unfortunately the observer was found to have been killed when the first bomb exploded.

L.A/C. G. WILLIAMS.

A/C.1 K. BLAND.

In June, 1941, ammunition in an aircraft exploded by spontaneous combustion. In spite of the explosions, A/C. Bland climbed on to the mainplane and unfastened the gun panels. By this time the ammunition tank was burning fiercely, so he released it from the gun. L.A/C. Williams carried away the burning tank, which started to explode while he was carrying it. The presence of mind and courage shown by these two airmen undoubtedly saved the aircraft and probably the lives of the air crews and armourers who were emptying the remaining ammunition tanks.

Roll of Honour

Air Ministry Casualty Communiqué No. 103.

THE Air Ministry regret to announce the following casualties on various dates. The next-of-kin have been informed.

Royal Air Force

KILLED IN ACTION (WHILE FLYING IN OPERATIONS AGAINST THE ENEMY).—F/O. B. D. White.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. H. F. Barron; Sgt. H. G. Burgess; Flt. Sgt. W. J. Grieve; P/O. C. R. C. Herbert; Sgt. E. A. R. Leavers; Sgt. J. A. Lennard; Sgt. E. Lewin; Sgt. J. W. H. Phelps; P/O. A. G. St. J. Ross; Flt. Sgt. A. C. W. Wells; Flt. Sgt. W. C. Wills; P/O. J. W. Sievers, D.F.C.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. S. W. Adair; Sgt. T. J. Air; Sgt. F. W. Baker; Sgt. W. H. Browell; Sgt. E. N. Brundish; Wing Cdr. A. L. Christian; Flt. Sgt. J. J. Clinch; Wing Cdr. F. C. Cole; Sgt. W. E. Craven; Sgt. D. W. E. Creedy; Sgt. R. H. C. Crook; Sgt. K. A. Dean; Flt. Sgt. J. Derbyshire; P/O. A. A. Ford; Sgt. G. Gibb; P/O. W. H. Goodall; Sgt. R. B. Hanmer; Sgt. W. C. Haynes; Sgt. H. F. Hurt; Sgt. J. E. Johnson; Sgt. A. Lee; Sgt. J. W. Mulford; Act. Flt. Lt. T. H. Myers; Sgt. J. W. Nightingarl; Sgt. S. O'Connor; Sgt. E. S. Phillips; Sgt. J. R. Ronnie; Sgt. R. C. Smith; Sgt. R. D. G. Stark; P/O. M. W. Tilley; P/O. A. K. Watson; F/O. E. C. Whitehead; Sgt. F. A. Whitehead; Flt. Lt. J. C. Whittall; Sgt. O. L. M. Williams; Sgt. R. E. Williams.

WOUNDED OR INJURED IN ACTION.—Flt. Lt. R. L. F. Day, D.F.C.; P/O. J. S. Holmes; Flt. Lt. T. L. Howell; Flt. Lt. A. M. Murphy.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. S. G. Hughes; Sgt. J. E. Olive; F/O. A. P. G. H. Sutton.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. E. O. Brooks; Sgt. A. V. Carpenter; Sqn. Ldr. P. G. S. Dickenson; Sgt. L. G. C. Dimond; Sgt. S. A. Hart; Sgt. M. S. Jacobs; Sgt. A. McKillop; Sgt. C. T. H. Mappin; Sgt. K. Naylor; Sgt. C. W. Onions; Sgt. J. H. Reid; Sgt. G McA. Thain; Sgt. A. A. Thomson; Sgt. B. Wallwork; Sgt. C. Walton; Sgt. D. E. Williams; Sgt. D. A. Willison.

PREVIOUSLY REPORTED PRISONER OF WAR, NOW REPORTED MISSING, BELIEVED KILLED IN ACTION.—Sgt. R. C. Hargrave.

MISSING.—Sgt. M. F. Carthy; Sgt. G. H. Chesman; Sgt. H. J. Cooper; Sgt. R. A. Cousens; F/O. K. L. Davies; P/O. A. J. Dearden; Act. Sqn. Ldr. D. B. Drakes; Sgt. B. R. Edis; Sgt. W. R. Furzey; Sgt. A. E. Glover; Sgt. G. L. Hall; Sgt. J. Halsall; Sgt. K. W. Holbrook; Sgt. P. Johnstone; Sgt. J. F. McGee; P/O. A. D. Moore; Flt. Lt. J. R. Noble; Sgt. D. W. Pike; Sgt. C. W. Robinson; Sgt. J. J. Robinson; F/O. A. A. Salter; F/O. P. N. Screeton; Sgt. P. Shane; F/O. E. V. Tate, D.F.C.; F/O. J. M. Tweedie; F/O. R. B. B. Wade; Sgt. W. A. Weaver; Sgt. M. A. Weaver; Sgt. R. Weir; Wing Cdr. J. O. Willis; P/O. J. M. Wyley.

PREVIOUSLY REPORTED PRISONER OF WAR, NOW REPORTED MISSING.—Sgt. L. A. Morris, Sgt. G. W. Robson.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE (WHILE ENGAGED ON NON-OPERATIONAL FLYING DUTIES OR ON THE GROUND THROUGH ENEMY ACTION).—A/C.1 R. E. G. Cockburn; L.A/C. R. F. G. Griffin; L.A/C. J. E. B. Hards; L.A/C. D. J. Laidman; A/C2 J. A. Morris; L.A/C.1 C. L. Morris; Sgt. C. G. A. Tabor; L.A/C. J. Ward.

KILLED ON ACTIVE SERVICE.—Sgt. J. M. F. Bell; F/O. C. E. Beloe; Sgt. S. W. Bradshaw; L.A/C. J. C. Cann; A/C.1 R. Chadwick; P/O. G. E. Eaton; P/O. G. L. Eyles; Flt. Lt. E. M. Frisby; Sgt. T. H. Hardisty; Sgt. J. Hubbard; Sgt. A. O. Johnston; Sgt. G. A. Johnstone; P/O. A. F. B. Ladefoged; Sgt. H. S. Loader; P/O. D. T. McLaren; Sgt. F. A. Mackey; Sgt. D. J. Marcus; Sgt. C. T. Martyn-Johns; Sgt. J. H. Mattingly; L.A/C. D. O. May; Sgt. E. S. J. T. Medder; P/O. J. E. Moodie; Sgt. F. L. Morgan; Sgt. T. A. Nesbitt; P/O. R. L. Newell; Sgt. T. W. Ogden; Sgt. G. F. Parkes; Sgt. S. G. Parrott; Sgt. R. J. Perrin; A/C.1 A. C. Popley; Sgt. D. W. Raley; P/O. H. L. Russell; L.A/C. R. J. Sheward; Cpl. K. P. Sexton; A/C.1 H. Sutcliffe; L.A/C. E. C. Thompson; Sgt. C. G. Tierney; P/O. K. W. Watson; Sgt. B. Wright; Sgt. H. Wright.

PREVIOUSLY REPORTED MISSING BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. J. H. Adamson; Cpl. R. O. Lenham; Flt. Lt. G. V. Nicholls; Sgt. S. E. Thurston.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—A/C2 A. R. M. Anderson; A/C.2 J. A. Auckland; A/C2 L. J. Austin; A/C.2 C. F. Bailey; Sgt. R. E. G. Clift; A/C.2 F. Clough; A/C.2 R. Denninson; A/C.1 N. Dickinson; A/C.1 A. T. Egan; A/C1 K. A. Elliott; A/C.1 B. A. McG. Ferguson; A/C.1 D. J. R. B. Gray; A/C.2 K. W. Gregory; A/C.1 A. Heath; Cpl. S. G. Iles; A/C.2 E. R. Jack; L.A/C. H. Jacques; A/C.1 E. A. James; A/C.2 S. J. Jerome; A/C.2 S. Jones; L.A/C. J. H. Kirkham; L.A/C. S. Leachman; A/C.1 A. K. Littlejohn; Sgt. H. I. Lotherington; A/C.2 J. McAllister; A/C.2 J. T. McCarthy; A/C.2 R. P. McGregor; A/C.1 A. McKinney; A/C.1 B. Malone; A/C.1 F. H. Marsh; L.A/C. N. R. Martin; A/C1 J. H. Masterton; A/C.1 A. Mathie; A/C.2 N. E. Mills; A/C.2 R. D. Moore; A/C.1 V. Morris; A/C.1 L. B. Mortimer; Cpl. A. D. Mowatt; Cpl. S. W. S. Muir; A/C.2 A. D. Munslow; A/C1. M. Murray; Cpl. H. W. Nudds; A/C.2 R. G. Ogg; A/C.1 J. Patterson; A/C.2 R. A. Phipps; A/C.2 L. N. Pitbladc; A/C.1 J. J. Quill; A/C.2 R. D. Rogers; A/C.2 D. C. Theobalds; A/C.2 I. G. Thomas; L.A/C. B. G. Wakefield; A/C.1 J. P. Williams; L.A/C. S. V. Wilmington.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Flt. Sgt. A. V. J. Bettridge; Sgt. J. J. Martin; Cpl. D. Trist.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—L.A/C. T. H. Turner.

DIED ON ACTIVE SERVICE.—A/C.2 S. Cross; A/C.1 R. T. Ferrier; Act. F/O. I. Gavahas; L.A/C. A. J. D. Glaisher; A/C.2 W. Heaps; L.A/C. G. W. Hooper; Sgt. F. G. Jones; L.A/C. D. Lipman; T/Cpl. J. Reid; Sgt. A. E. Rex; L.A/C. J. Riley; Cpl. G. Topham; L.A/C. D. G. Walker.

PREVIOUSLY MISSING, NOW PRISONER OF WAR.—A/C.1 G. Burwell; Cpl. J. Woods.

Royal Australian Air Force

PREVIOUSLY REPORTED MISSING BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O T. G. Joyce.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. A. H. T. Cook; Sgt. J. W. C. Morris; P/O. R. L. O. Ryder.

KILLED ON ACTIVE SERVICE.—P/O. H. H. Lawson; A/C.1, H. A. Lonergan.

Royal Canadian Air Force

MISSING, BELIEVED KILLED IN ACTION.—Sgt. W. M. Chambers; Sgt. R. W. Gardner; P/O. D. A. Simpson.

MISSING.—Sgt. C. D. Cooling; Sgt. N. G. Hettrick.

KILLED ON ACTIVE SERVICE.—Sgt. I. R. Trafford.

Royal New Zealand Air Force

MISSING, BELIEVED KILLED IN ACTION.—P/O. R. O. Foster; Sgt. J. S. Wilson.

MISSING.—P/O. L. P. Bourke; Sgt. F. D. Glasgow

South African Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED KILLED IN ACTION.—Lt. R. C. W. Miller.

DIED ON ACTIVE SERVICE.—Air Mech. G. J. Hicks.